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WATER SUPPLY AND WATER QUALITY CONTROL STUDY, MILL CREEK PROJECT, WALLA WALLA RIVER BASIN, WASHINGTON-OREGON

Public Health Service
Portland, Oregon

December 1965

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FINAL REPORT PB 218 299

WATER SUPPLY & WATER QUALITY CONTROL STUDY

Mill Creek Project

Walla Walla River Basin .....Washington-Oregon

DECEMBER 1965

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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

WATER SUPPLY AND WATER QUALITY CONTROL STUDY

MILL CREEK PROJECT
WALLA WALLA RIVER BASIN, WASHINGTON-OREGON

A survey has been made which discloses a need for storage for municipal and industrial water supply and for stream flow regulation for water quality control. This conclusion is based on economic, demographic, and engineering studies. Future conditions are based on projected population and industrial growth.

Prepared at the Request of the District Engineer,
U. S. Army Engineer District, Walla Walla
Corps of Engineers, Walla Walla, Washington

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Water Supply and Pollution Control Program, Pacific Northwest
Region IX - Portland, Oregon

DECEMBER 1965

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I. INTRODUCTION

A. Request and Authority

The request for this investigation was made by the U. S. Army Engineer District, Walla Walla Corps of Engineers, Walla Walla, Washington, by letter dated November 21, 1963. The request was for an evaluation of storage needs for municipal, industrial, and water quality control purposes, and for an estimate of benefits assignable to project storage for these purposes.

Authority for the investigation is: (1) The "Memorandum of Agreement", dated November 4, 1958, between the Departments of the Army and Health, Education, and Welfare, relative to the Water Supply Act of 1958, as amended (43 U.S.C. 390b); and (2) The "Federal Water Pollution Control Act, as amended (33 U.S.C. 466b(b))".

B. Purpose and Scope

This investigation was undertaken by the Public Health Service, Division of Water Supply and Pollution Control, to determine the potential needs for and value of storage for municipal, industrial, and quality control purposes. Water requirements were examined for areas within Walla Walla and Columbia Counties, in Washington, and Wallowa and Umatilla Counties, in Oregon. Future needs were projected to the year 2010, with an interim point at 1985. An economic base study and forecast of future population and industrial growth was prepared for this purpose and is summarized in this report.

C. Acknowledgments

This study was aided materially by officials of the Washington State Department of Health, Washington Pollution Control Commission, Washington State University, Cities of Walla Walla and College Place, County of Walla Walla, Washington State Department of Game, and the Blalock and Gose Irrigation Districts. The use of information contained in the bibliography is also acknowledged.

II. SUMMARY OF FINDINGS AND CONCLUSIONS

A. Summary of Findings

1. The proposed project is located in the Walla Walla River Basin in Southeastern Washington and Northeastern Oregon. The project site is on Mill Creek about 9 miles upstream from the City of Walla Walla, Washington (see Figure 3 at back of report).

2. The reservoir would have a total storage capacity of about 65,000 acre-feet and would be operated to serve needs for flood control, irrigation, recreation, fish and wildlife, municipal and industrial water supply, and water quality control.

3. The drainage area above the project site is approximately 90 square miles. The annual runoff from this area varies between 50,600 and 132,100 acre-feet, and averages 83,300 acre-feet per year. Much of the stream flow below the site is diverted for irrigation. Low stream flows at the City of Walla Walla have averaged 1 cfs during the late summer months due to these diversions.

4. With the exception of occasional turbidity and vegetative coloring matter in the water at the project site, the quality of water is excellent for all uses. The City of Walla Walla obtains a large portion of its supply from the watershed area above the site.

5. The quality of stream water below the City of Walla Walla during summer months is seriously degraded by municipal and industrial waste and irrigation return flows. Nuisance conditions and conditions

hazardous to fish life and to public health have been observed throughout the lower portion of Mill Creek, a distance of about six miles.

6. Water uses and factors affecting water quality in the area are those associated with the growing and processing of agricultural products. Economic studies show trends toward continued expansion of this base. Canning and freezing of vegetables is the major industrial activity in the area at this time.

7. The 1960 population of the economic base study area (excludes Touchet River drainage area) was 45,660, of which 36,660 persons resided in urban areas and 9,000 resided in rural areas. About 70 per cent of the base study area population reside in the area that would be affected by the proposed project. The urban population in the immediate vicinity of the project is about 32,000, and is projected to be about 46,000 by 1985 and 75,500 by the year 2010. Rural population of the economic base study area is expected to stabilize at about 8,000 by the year 1985.

8. Municipal and industrial water use in the economic base study area (excluding Touchet River drainage area) in 1962 was about 18 million gallons per day (MGD) or 20,200 acre-feet. With future growth, the demand is projected to be about 30 MGD (33,165 acre-feet) by 1985 and 47 MGD (52,165 acre-feet) by 2010. About two-thirds of this demand (19.2 MGD in 1985; 30.4 MGD in 2010) is expected to take place in the vicinity of the proposed project.

9. Developed sources of supply at Walla Walla are barely enough to meet present demands and, for this reason, the City has shown an interest in obtaining storage in the proposed project for future supply.

10. Stream waters below the proposed project te support a limited game fishery and fall runs of steelhead trout. With additional stream flow, improved water quality, and fish passage facilities at diversion dams, a significant salmonid fishery, according to the Fish and Wildlife Service, could be established.

11. Raw organic waste production in the economic base study area is greatest during the food processing seasons (May through November). Measured in terms of biochemical oxygen demand (BOD), the average daily production of raw waste during recent processing seasons has been about 662,000 population equivalents (PE), of which about 311,000 PE were produced in the Walla Walla-College Place area along Mill Creek. Increases to 450,000 PE and 720,000 PE per day by 1985 and 2010, respectively, are projected for this area.

12. Present waste treatment and land disposal procedures, in terms of wastes received in Mill Creek from the Walla Walla-College Place area, accomplish about 75 per cent BOD reduction.

B. Conclusions

1. Municipal and industrial water demands in the project area will exceed available supplies by about 10.2 MGD (11,500 acre-feet) by the end of the study period. Assuming that additional ground

water will be developed to meet demands in the next few years, the first need for storage is expected to begin about the year 1980.

2. With an exchange of storage for additional water from the presently protected watershed, sedimentation with simple chlorination can be expected to provide water of satisfactory quality for domestic and food processing use for the foreseeable future.

3. Present procedures for waste control along Mill Creek provide inadequate protection of stream water quality. Future waste production will create further damage in terms of additional losses in fish production, increased hazards to public health, losses in recreation opportunities, and reduced land values.

4. Adequate waste treatment (at least 85 per cent BOD reduction), controlled surface and subsurface drainage, and assured quantities of stream flow to maintain minimum dissolved oxygen (DO) levels at 5 mg/l are needed to restore Mill Creek to a multiple-use stream, including a "put-and-take" game fishery.

5. With adequate source control of wastes, the total average flow required in Mill Creek during summer and fall months by the end of the study period to provide optimum use of Mill Creek would be about 95 cfs (5 mg/l DO). On a one-in-ten year low-flow frequency basis, there would be an average deficit of about 85 cfs, requiring an annual draft-on-storage of 30,000 acre-feet. An annual draft-on-storage of 54,500 acre-feet would be required to maintain water quality for salmonid fish production (6 mg/l DO). The minimum draft-on-storage for which benefits would accure would be 10,300 acre-feet (2 mg/l DO).

This quantity of storage would provide only minimum protection of aesthetic values and would not support fish life.

6. The value of water for municipal and industrial water supply is considered equal to the costs involved in its development by local users. The value of storage for this purpose in Mill Creek Project was determined by estimating local costs to construct storage at the most likely site on Mill Creek in the absence of the project adjusted to an equivalent Federal annual expenditure. At 3.125 per cent interest, 100-year alternate project life, and first need beginning in 1980 (assumed project completion in 1970), the annual value of 11,500 acre-feet of storage in the project for municipal and industrial supply was found to be $321,800.

7. Beneficiaries of water quality improvement and maintenance in the project area, such as those associated with general aesthetics, recreational potential, etc., are identifiable only in general terms and their monetary values are not accurately measurable by known means. The minimum value of these quality control benefits, however, is considered to be equal at least to the cost of providing alternative single-purpose storage to accomplish water quality goals in the absence of the project. The most likely single-purpose alternative site, with sufficient capacity to provide the required regulation, is the Corps of Engineers site on Mill Creek.

8. The minimum value of benefits associated with quality control release requirements for full use of Mill Creek (including use for salmonid fisheries), based on a 100-year alternate project

life, with first need beginning at the time of project completion and at 3.125 per cent interest, is estimated to be $840,000 or $15.50 per acre-foot. For an annual draft-on-storage of less than 54,500 acre-feet, the annual value would be reduced at the rate of $15.50 per acre-foot down to the minimum of 10,300 acre-feet (nuisance abatement), below which no value can be assigned to storage for water quality control.

9. Controlled water quality will have an important impact on the area for which regulation would be provided. Mill Creek flows through the City of Walla Walla and on through a number of communities and suburban areas where substantial population growth is expected. Intangible benefits, such as public health and the protection of aesthetic values associated with the stream and its condition, will be of even greater importance as population density increases.

10. The benefits derived from water quality maintenance in Mill Creek and Walla Walla River are both tangible and intangible and are widespread both in area and type of beneficiary.

III. PROJECT DESCRIPTION

A. Location

The proposed project is located on Mill Creek, in Southeastern Walla Walla County, Washington, and is within the drainage area of the Walla Walla River. A small portion of the drainage area above the proposed dam is in Umatilla County and Wallowa County, Oregon (see Figure 3, Location Map, back cover).

The drainage area above the project dam site is approximately 90 square miles. The area of the Mill Creek watershed is about 100 square miles, 96 square miles of which are above the City of Walla Walla. About 22,000 acres of national forest land in the upper part of the watershed have been closed to trespassing and livestock to protect the Walla Walla City water supply.

Mill Creek originates on the western slopes of the Blue Mountains in Northern Oregon and Southern Washington, about 21 miles east of Walla Walla. The stream flows in a westerly direction through the City of Walla Walla to a point 6 miles west of the City where it enters the Walla Walla River. Mill Creek is characterized by steep slopes of 35 to over 100 feet per mile throughout its length.

In the reaches of Mill Creek adjacent to Walla Walla, barriers have been constructed about every 60 feet for channel stabilization and protection during flood discharge. These barriers create pools conducive to resident fish propagation and also provide considerable aeration of the stream.

Stream flow data at the dam site show a mean annual flow of 115 cfs or 83,300 acre-feet per year. On a one-in-ten year low-flow recurrence interval basis, the mean annual flow is 74 cfs, with the minimum-month flow being about 26 cfs.

Water quality in Mill Creek and the Walla Walla River below Mill Creek has seriously deteriorated due to municipal and industrial waste discharges during the critical summer months. In passing through and downstream from the City of Walla Walla, Mill Creek presents a health hazard, produces objectionable odors, and, because of slime growths, is unattractive aesthetically.

The quality of surface water in the upper Mill Creek Watershed is subject to surface runoff turbidities and vegetative color matter during short periods in the early spring when runoff is high. The water above the site is generally low in mineral content and essentially free of man-caused bacteriological pollution. (Water quality data are presented in Chapter VIII and in Appendix B.)

B. Proposed Project

As shown in Figure 3, Location Map (back cover), the Corps of Engineers' proposed storage project on Mill Creek is immediately below the confluence of Mill Creek and Blue Creek, 9 miles above the City of Walla Walla. The reservoir, as proposed, would have a capacity of about 65,000 acre-feet, with 10,000 of this total below the minimum pool elevation to provide for sediment accumulation and a permanent pool for recreation and fish habitat.

The project would serve the purposes of flood control, irrigation, recreation, fish and wildlife, municipal and industrial water supply, and water quality control. The City of Walla Walla has expressed an interest in the project for water supply purposes.

IV. STUDY AREA DESCRIPTION

A. Location and Boundaries

The study area includes portions of Walla Walla and Columbia Counties, in Washington, and Wallowa and Umatilla Counties, in Oregon. For municipal and industrial water supply and water quality control study purposes, the area covered is all of the Walla Walla River Basin, except that portion having drainage to the Touchet River (see Figure 3, Location Map, back cover).

The major water service areas within the study area are Walla Walla-College Place, Washington, and Milton Freewater-Weston, Oregon. The Walla Walla-College Place and downstream areas would be directly influenced by the Mill Creek Project and, therefore, are given greater coverage in this report.

The chief contributory drainage to Mill Creek is Blue Creek, which drains about 17 square miles of mountainous, forested terrain and enters Mill Creek about 9 miles above Walla Walla. Yellowhawk and Garrison Creeks are small delta alluvium branches of Mill Creek which pass through Walla Walla and join the Walla Walla River upstream from the mouth of Mill Creek.

The economic base study area for this report includes all of Walla Walla County, Washington, and that part of the northeastern portion of Umatilla County, Oregon, included in the 1960 U. S. Census County Divisions of Athena, Umapine, Crockett, Upper Walla Walla, and Weston. These political divisions correspond very closely to the physical boundaries of the Walla Walla River Basin.

B. Physical Features

1. Geology and Soils

The Blue Mountains, which form the upper watershed of Mill Creek, are a northeasterly trending anticlinal uplift of lava flows, with local evidence of faulting along the flanks. Walla Walla Valley lies immediately west of the mountains and is a structural depression bounded on the southwest by abrupt fault scarps and is filled with clastic deposits. In the center and westerly end of the Valley, fine-grained materials are common; in the easterly part and extending well up in the flanks of the Blue Mountains are coalesced fans of coarse gravel and cobble deposited by the streams emerging from the mountains. These alluvial fans have been entrenched by the present streams.

2. Cover Vegetation

The upper reaches of the basin are heavily forested, but the lower basin is primarily agricultural land or urban area. Principal dry-land crops are wheat and peas, while the principal irrigated crops are alfalfa hay, alfalfa seed, irrigated pasture, sugar beets, strawberries, asparagus, lettuce, onions, cabbage, spinach, sweet corn, and carrots.

3. Topography

The elevation of the Mill Creek Basin ranges from 5,000 feet at the higher elevations to 600 feet at the confluence of Mill Creek with the Walla Walla River. Mill Creek, characterized by slopes of 35 to over 100 feet per mile, is confined to a narrow, forested, steep-sloped canyon for the first 15 miles of its course. Downstream from this point, the terrain changes to agricultural bench land and gradually forms a valley fan several miles wide. The area around the City of Walla Walla is within this valley fan.

4. Climate

The area has a moderate climate, with mean annual temperatures ranging from 53 degrees at Walla Walla to about 38 degrees at maximum elevations. Mean annual precipitation ranges from about 15 inches at Walla Walla to 50 inches at maximum elevations, with approximately 60 per cent of the annual precipitation occurring during the five months of November through March and about 3 per cent appearing in July and August. At higher elevations, much of the precipitation occurs as snowfall during the winter months and becomes runoff in warmer weather. The area has a long growing season at lower elevations and an abundance of sunshine.

V. WATER RESOURCES OF THE STUDY AREA

A. Surface Water

The existing Corps of Engineers' flood protection works in the basin consist of an off-stream flood control reservoir having a capacity of 6,700 acre-feet (see Schematic Diagram, Figure 1), channel improvements below the flood control reservoir, repairs and improvements to a locally constructed concrete flood channel through the City of Walla Walla, and the development of a recreation area near the flood control reservoir. Flood water is diverted to storage in the off-stream reservoir by means of diversion works on Mill Creek. Stored water is released through the base of the storage dam. Normal flow of water past the diversion works is apportioned by means of two concrete structures to the three delta streams--Yellowhawk, Garrison, and Mill Creek.

Stream flows in Mill Creek are largely committed to irrigation. Decree No. 19075 of the Superior Court of the State of Washington in and for the County of Walla Walla, dated September 12, 1928, adjudicated water rights in the Walla Walla Valley. The decree lists rights to serve about 15,130 acres of land. Important stipulations in the decree are summarized briefly below:

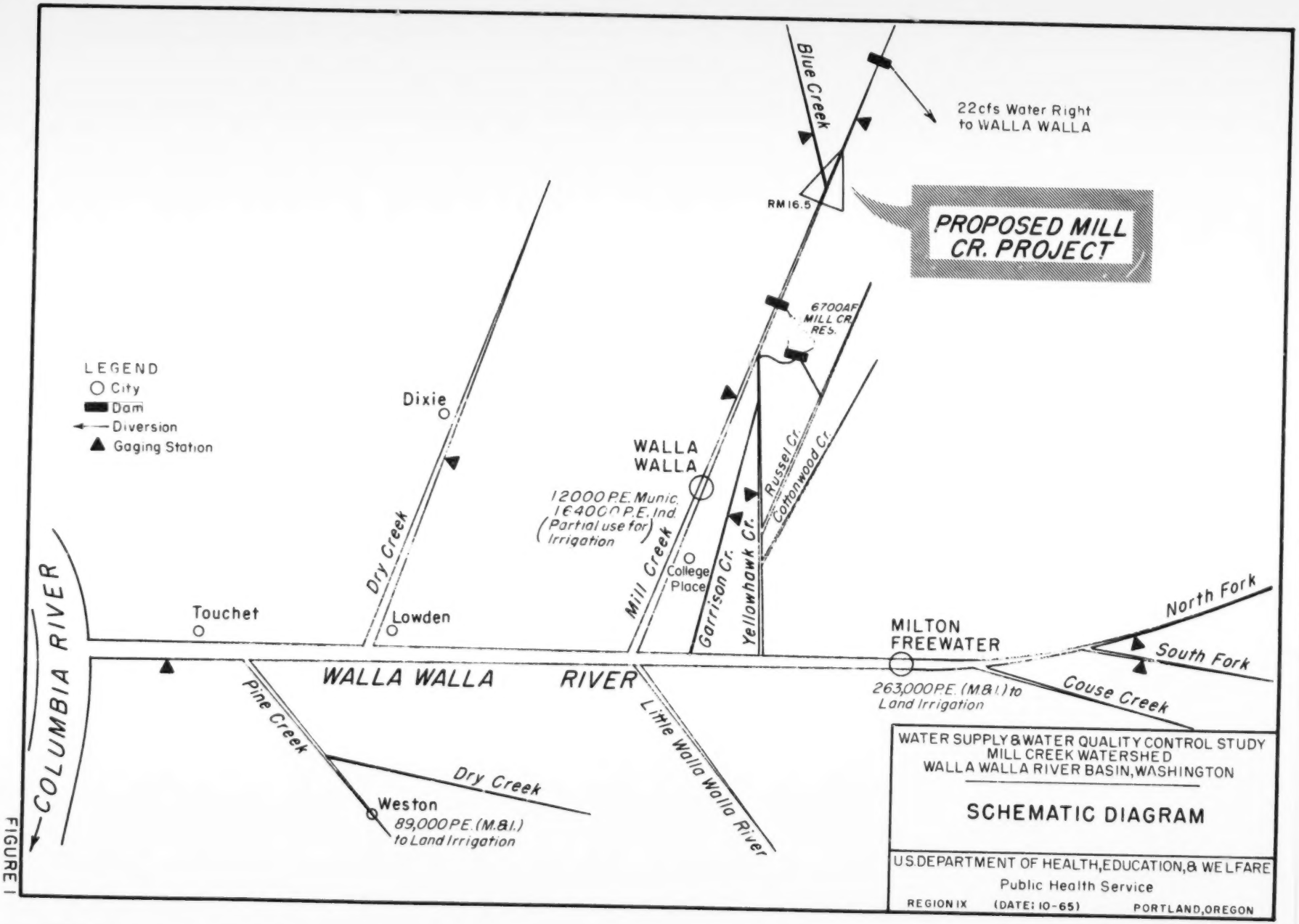
Blue Creek
22cfs Water Right to WALLA WALLA
RM 16.5
PROPOSED MILL CR. PROJECT
6700AF MILL CR RES.
LEGEND
City
Dam
Diversion
Gaging Station
Dixie
WALLA WALLA
12000 P.E. Munic.
16400 P.E. Ind.
(Partial use for) Irrigation
Dry Creek
Mill Creek
College Place
Garrison Cr.
Yellowhawk Cr.
Russel Cr.
Cottonwood Cr.
Touchet
Lowden
MILTON FREEWATER
North Fork
South Fork
Couse Creek
263,000 P.E. (M&I) to Land Irrigation
COLUMBIA RIVER
WALLA WALLA RIVER
Pine Creek
Dry Creek
Little Walla Walla River
Weston
89,000 P.E. (M&I) to Land Irrigation
WATER SUPPLY & WATER QUALITY CONTROL STUDY
MILL CREEK WATERSHED
WALLA WALLA RIVER BASIN, WASHINGTON
SCHEMATIC DIAGRAM
U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
Public Health Service
REGION IX (DATE: 10-65) PORTLAND, OREGON

FIGURE 1

(1) Seasonal quantities of rights are one seventy-fifth of a cfs per acre during 1 April through 30 June, one one-hundredth of a cfs per acre during 1 July through 30 September and, to the extent required to provide a yearly total of 5 acre-feet per acre, one-fiftieth of a cfs per acre during 1 October through 31 March.

(2) The City of Walla Walla has a continuous right to divert 22 cfs for municipal use.

(3) Walla Walla Milling Company has a right to non-consumptive use of 25 cfs between 1 October and 31 May and all water available between 1 June and 30 September at its mill on Yellowhawk Creek.

(4) These rights apply to all flow originating in upstream tributaries.

(5) The rights are classified for priority according to dates of the original appropriation of water. When water supplies are insufficient to satisfy part of the rights, the older rights are honored first. For rights of equal age, water supplies are distributed in proportion to total rights involved.

A 1930 decision by the U. S. Supreme Court gives the State of Oregon a superior right to water originating in Oregon.

The annual yield of Mill Creek below its major tributary, Blue Creek, has varied from 50,600 acre-feet to 132,100 acre-feet and has averaged 83,300 acre-feet. Over 75 per cent of this yield occurs from December through May. Table V-1 summarizes the stream flow data for Mill Creek at the proposed dam site and at Walla Walla. Gaging stations are shown on Figure 3, Location Map (back cover).

TABLE V-1
SUMMARY OF STREAM FLOW DATA[a]
MILL CREEK BASIN

MILL CREEK	Mean Annual Flow				Minimum-Month Flow			
	Mean Year	Min. Year	1/5 Yr. Freq.[b]	1/10 Yr. Freq.[c]	Mean	Min.	1/5 Freq.[b]	1/10 Freq.[c]
At Dam Site								
Av.Monthly Flows, cfs	115	70	88	74	35	25	29	26
Annual Yield, Acre-Feet	83,300	50,600	63,700	53,600				
At Walla Walla								
Av.Monthly Flows, cfs	75	34	50	37	4	1	4	1

a/ Based on USGS Records, Water Years 1942-62.

b/ Expected to occur once in five years.

c/ Expected to occur once in ten years.

Diversions, primarily for irrigation, made immediately above Walla Walla, are responsible for the depletions between the two gaging stations shown in Table V-1. Monthly hydrographs for the annual flows, shown in Table V-1, are presented in Appendix A.

There are rights also to divert water from the upper Walla Walla River below the Milton-Freewater gage. With full use of water for irrigation, as provided by these rights, there would be periods of zero flow in the Walla Walla River above the mouth of Mill Creek.

B. Ground Water

According to U. S. Geological Survey studies, the ground water supply originating in the Mill Creek Watershed is estimated to be 75,000 acre-feet per year. It is also estimated that about one-half of this amount returns to Mill Creek by escaping from underground sources as spring or summer flow.

The City of College Place uses ground water as its source of water supply, and the City of Walla Walla uses ground water to augment its surface supply obtained from Mill Creek.

The development of ground water in the Walla Walla-College Place service area is discussed in more detail in Chapter VII.

VI. THE ECONOMY

A. General

The demand for water for municipal and industrial purposes, and the amount and character of waste waters resulting from such uses are determined largely by the activities associated with a region's economic base. The purpose of this section is to present economic and demographic data for use in projecting the needs for water for municipal and industrial purposes and for estimating the future amounts and types of waste material that may be expected to enter stream waters of the Walla Walla River system.

B. Present

1. Economic Activities

The economy of the study area depends largely on agriculture and food processing. Although grains occupy the greatest acreage, the most important crop is green peas, upon which a substantial food processing industry in Walla Walla is based.

Development of agriculture in the study area in recent years has been uneventful. Farm consolidation was apparent, with the total number of farms reduced 10.9 per cent between 1954 and 1959 in Walla Walla County. The amount of land in farms and of crop land harvested remained almost unchanged between 1954 and 1959, with greater per-acre output providing increased production without any reduction in fallowing. The amount of pasture land was essentially unchanged, and the number of acres irrigated increased by 4.3 thousand acres or 13.2 per cent.

In terms of crop patterns, grain plantings declined, with some increase for barley failing to offset the lesser acreage devoted to oats and wheat. Cattle populations of the two counties were stable from 1954 to 1959, and the number of sheep roughly doubled.

Table VI-1 summarizes the agricultural data of Walla Walla County.

TABLE VI-1
AGRICULTURE AND LAND USE PATTERNS
WALLA WALLA COUNTY, 1959 a/

Number of Farms	981
Land in Farms (acres)	822,729
Average Size of Farms (acres)	838.7
Land Irrigated (acres)	37,296
Crop Land Harvested (acres)	279,538
Not Harvested & Not Pastured (acres)	239,328
Crop Land Pastured	29,061
All Other Pasture (acres)	234,625
ACRES DEVOTED TO PRINCIPAL CROPS	
Winter Wheat	152,893
Barley	62,554
Green Peas	16,285
Spring Wheat & Other Grains	17,513
Hay	15,186
Field Seeds	5,119
Sugar Beets	4,214
Vegetables (incl. Potatoes)	5,122
Dry Peas	4,234
Orchards & Berries	237
LIVESTOCK POPULATIONS	
Cattle & Calves	26,829
Hogs & Pigs	7,238
Sheep & Lambs	23,263

a/ U. S. Census of Agriculture, 1959

A vigorous food processing industry is dependent on the agricultural output of the Walla Walla Basin. Six large plants in the basin can or freeze the peas and other vegetables grown in the area, and at the peak of the season over 4,000 people are employed by the food processors.

Food processing is highly seasonal, with activity beginning to rise in the second quarter of the year and peak employment occurring during June and July, near the harvest time for peas. Introduction of other vegetable products creates a second, but more limited focus of activity in the early fall.

Service industries have reached an unusual level of development for a resource-oriented region. Whitman College, a 350-bed Veterans' Hospital, and the Washington State Penitentiary, at Walla Walla, are responsible to a considerable degree for the high ratio of service employment. Both transportation and retail trade provide employment at levels somewhat beyond what would appear to be required by the population of the area. This may probably be ascribed to relative inefficiencies of distribution in an area of relatively low population density, as well as the need to transport a large amount of bulk materials originating in the agricultural and food processing sector of the economy.

Pulp and paper production is of importance to Walla Walla County, but is centered at Wallula, Washington, outside the study area. Forest lands of the region are utilized by local sawmills in Mill Creek Watershed area to produce merchantable timber and pulp logs for rail shipment to mills.

2. Population

As shown in Table VI-2, population in the study area rose rapidly between 1940 and 1950, but growth slowed sharply in the next decade. Between 1950 and 1960 there was a decline in the number of rural residents and population growth slowed perceptibly in the towns.

TABLE VI-2
POPULATION GROWTH, 1940-1960[a/]
STUDY AREA

Region	Population			Annual Growth Rate (%)		
	1940	1950	1960	1940-50	1950-60	1940-60
Walla Walla Area	19,381	27,276	31,765	3.5	1.6	2.5
Rural Washington	4,903	5,800	4,550	1.6	-2.5	-0.4
Milton-Freewater	2,569	2,843	4,110	0.9	3.8	2.4
Weston	489	679	783	3.3	1.4	2.4
Rural Oregon	5,377	5,405	5,015	0	-0.8	-0.4
Study Area	32,719	42,003	46,223	2.5	1.0	1.7
Oregon State				3.3	1.6	2.3
Washington State				3.1	1.8	2.5

a/ U. S. Census of Population, 1950 and 1960.

3. Land Uses

The level of irrigation development in Walla Walla and Umatilla Counties is not high compared to other Pacific Northwest agricultural areas.

Irrigation practices in the two counties differ, to some extent, from one another. For example, in 1959, about 40 per cent of the irrigation in Umatilla County was accomplished by use of sprinklers, whereas in Walla Walla County 65 per cent was by sprinklers.

In 1959, Umatilla County organizations provided water to 24.7 thousand acres and cooperated with other farm supplies to irrigate another 12.2 thousand acres. An additional 8 thousand acres in Umatilla County were irrigated with farm ground water, 6.7 thousand acres were irrigated with farm surface water, and 4.7 thousand acres were irrigated by a combination of ground and surface water. In Walla Walla County, irrigation organizations provided water for only 7.1 thousand acres, while 8 thousand acres were irrigated with farm ground water, 4.6 thousand acres with farm surface water, and 8.8 thousand acres with a combination of ground and surface water from farm sources.

C. Future Economic Growth

The future expansion of the economic base of the study area is presumed to follow trends already in effect. Agriculture is expected to provide a significant portion of the region's total output. Greater use of land of less than highest agricultural capability, more intensive utilization of crop land presently in fallow, and additional irrigation in the future is expected to make large scale increases in agricultural output possible. Crop patterns are expected to demonstrate increasing attention to vegetables and forage, with decreasing acreage in food grains. A marked increase in potato growing, for which the area is well suited, is a distinct possibility.

Based on the area's ability to increase agricultural output, further expansion of food processing is anticipated. Growth in the output of food products in this area relates to national population, since the bulk of regional production is sold in national markets.

On this basis, gross output is predicted to rise at a rate in excess of the rate of national population growth (i.e., about 1.8 per cent per year, based on U. S. Census Bureau projections of population). Production is expected to continue to stress the same types of vegetables now produced in the area, with more attention in the future to later-maturing vegetables to balance out the seasonal production pattern enforced by peas. Additional irrigation, inshipments, cold storage of raw materials, continuing shift of food production from urbanizing California to the Pacific Northwest regions are all calculated to enter into the equation suggesting output growth at a rate greater than that of population increase and over an extended processing season. The appearance of potato processing is possible. Employment is forecast to increase at the same rate as production.

Growth of other manufacturing is not expected to be substantial, since the study area lacks other natural resources and is distant from major market areas.

Construction employment, abnormally high for several decades as a result of a series of major public works, must be expected to come closer to levels which the local economy can maintain. However, the relatively undeveloped nature of the region suggests a level of construction somewhat higher than the national average.

It appears that services are adequately represented in the study area and that the service ratio is not likely to rise in the immediate future. Increased population and urbanization, together with the

national trend to greater concentrations on services, is expected to increase the service ratio slightly in the 1985-2010 period.

These production factors are summarized, in terms of their projected impact on the labor force, in Table VI-3.

TABLE VI-3
DISTRIBUTION OF LABOR FORCE
STUDY AREA

Industry	Number Employed (thousands) 1960	1985	2010
Agriculture, Forestry, Fisheries & Mining	2.6	2.3	2.3
Construction	1.8	1.6	2.3
Manufacturing:			
Lumber & Products	0.5	0.6	0.8
Pulp & Paper	0.0	0.5	0.6
Food Processing	1.4	2.1	3.4
All Other	0.8	1.2	1.8
Services	11.8	17.3	26.8
Unemployed	1.0	1.0	1.5
Labor Force	20.9	26.6	39.5

D. Future Population

Table VI-4 shows the present and projected distribution of population in the study area. The rural portion of the study area population was forecast to remain constant on the strength of the number of employment opportunities to counter declining agricultural employment--notably the pulp and paper mill at Wallula. The projection of population

is based on the assumption that the ratio of the area's labor force to total population will be the same as the national ratio in 1960.

TABLE VI-4
DISTRIBUTION OF POPULATION
STUDY AREA

Location	Population		
	1960	1985	2010
Mill Creek Watershed Area:			
Walla Walla	24,536	35,600	58,400
Suburban Walla Walla	3,200	4,600	7,600
College Place	4,031	5,850	9,600
Upper Walla Basin Area:			
Milton-Freewater	4,110	5,970	9,800
Weston	783	1,140	1,870
Rural Area (entire study area)	9,000	8,000	8,000
TOTAL	45,660	61,160	95,270

Note: An annual growth rate of 1.5 per cent was used for period 1960-1985, and 2.0 per cent from 1985-2010 for the urbanized areas. Rural area assumed to decrease in population.

VII. WATER REQUIREMENTS--MUNICIPAL AND INDUSTRIAL

A. Past and Present

1. Study Area

Municipal and industrial water use in the study area in 1962 averaged about 18 MGD (20,150 acre-feet annually), as shown in Table VII-1.

TABLE VII-1
MUNICIPAL AND INDUSTRIAL WATER USE
STUDY AREA, 1962
(MGD)

Location	Municipal	Industrial	Total
Mill Creek Watershed Area:			
Walla Walla	9.1	3.0	12.1
College Place	0.7	---	0.7
Upper Walla Walla Basin Area:			
Milton-Freewater	2.2	2.1	4.3
Weston	0.15	0.71	0.86
TOTAL	12.15	5.81	17.96

2. Mill Creek Watershed Area

a. City of Walla Walla

The City of Walla Walla utilizes both ground water and surface water for supply. Surface water is obtained from Mill Creek (Figure 1, Page V-2) above the proposed Mill Creek Project site, about 14 miles east of the City. The contributing Mill Creek watershed area is owned by the U. S. Forest Service and is closed to trespassing and grazing of livestock in order to protect the quality of water supply.

Screening, sedimentation, and chlorination are provided in facilities located 4 miles downstream from the point of diversion. The capacity of the gravity transmission line leading from these facilities to an open reservoir near Walla Walla is 15.2 MGD or slightly in excess of the 14.3 MGD (22 cfs) water right which the City holds on Mill Creek. The Mill Creek supply is not used during short periods of high surface runoff in the early spring because of high turbidities and color.

The Mill Creek supply is supplemented by six city-owned wells, used only during periods of peak demand or when the quality of Mill Creek does not permit its use. All six wells tap the Columbia River basalt aquifer, which yields good quality water. The total short-term capacity of the six wells has been estimated to be 15.7 MGD.

Mill Creek water in the supply area is soft and generally of good quality. The ground water supply is reportedly of good bacteriological quality and is reasonably soft. The supply is not chlorinated.

During the period 1951 to 1960, the total annual demand on the water system increased from 9.2 MGD (3,368 MG) to 11.7 MGD (4,285 MG), representing an increase of about 27 per cent. Water consumption by the food processing industry more than doubled during this period.

In 1962, approximately 27,500 people were served by the water system. Table VII-2 summarizes the 1962 water demand for the City of Walla Walla.

TABLE VII-2
1962 WALLA WALLA WATER DEMAND

Month	Municipal [a]			Industrial [b]			Total Water Use		
	MGD	MG	Ac-Ft.	MGD	MG	Ac-Ft.	MGD	MG	Ac-Ft.
Jan.	6.8	211	650	1.0	32	95	7.8	243	745
Feb.	7.8	217	665	1.0	29	90	8.8	246	755
March	7.6	236	725	1.0	32	95	8.6	268	820
April	6.8	203	625	2.0	61	185	8.8	264	810
May	6.4	199	610	3.5	109	335	9.9	308	945
June	12.6	377	1,160	5.0	151	465	17.6	528	1,625
July	15.8	489	1,500	6.5	201	620	22.3	690	2,120
Aug.	13.0	403	1,240	3.6	113	345	16.6	516	1,585
Sept.	10.5	314	965	3.6	107	325	14.1	421	1,290
Oct.	7.4	230	705	3.8	118	365	11.2	348	1,070
Nov.	7.0	211	650	2.8	85	260	9.8	296	910
Dec.	6.6	204	625	2.8	88	270	9.4	292	895
TOTAL	9.1	3,294	10,120	3.0	1,126	3,450	12.1	4,420	13,570

a/ Includes commercial, residential, public utilities, losses, etc.
b/ Essentially food processing.

The recorded municipal demand at Walla Walla was 3,294 MG (9.1 MGD) in 1962. About 1,770 MG (4.85 MGD) of this total could not be accounted for and is believed to have been lost from the system and/or consumed by non-metered users. At present, the unaccounted for water represents about 54 per cent of the total annual municipal demand, which compared to newer water distribution systems is relatively high. Based on the served population and the 1962 average daily municipal demand of 9.1 MGD, which includes unaccounted for water, the per capita water usage is 328 gallons per day (GPD). By omitting the unaccounted for water from the computation, the per capita demand is 155 GPD. As this is more in line with usages in similar areas, the major portion of unaccounted for water is believed attributable to losses in the system.

b. City of College Place

The City of College Place, Washington, utilizes two centrally located artesian wells for its water supply. With heavy pumping, the static water level drops to about 75 feet below the ground surface in September and October. Drawdown is about 8 feet during this period. (Walla Walla College is served by a separate well owned by the college.) The available yield of these wells (4.6 MGD) is more than adequate to meet present needs. The quality of this water is satisfactory and treatment is not provided.

The annual demand on the municipal system at College Place, which served about 3,000 people in 1962, averaged 0.56 MGD or 185 GPCD. The maximum weekly demand was 1.85 MGD, occurring in July. The total annual water production in the College Place area, including estimated usage by the college, was 256 MG (0.7 MGD) in 1962.

3. Upper Walla Walla Basin Area

a. City of Milton-Freewater

Milton-Freewater, Oregon, obtains water primarily from six wells, ranging in depth from 500 to 900 feet below land surface. The well water is treated by pressure filter and chlorination. An additional municipal well is under development to provide additional water for increased cannery production. Total dependable yield of the six wells is estimated to be about 8 MGD. Approximately 90 per cent of the total Milton-Freewater demand is satisfied by these wells.

During peak-demand periods, the South Fork of the Walla Walla River is utilized as a source for water supply by use of a gravity transmission system, which employs plain settling and filtration. Umatilla Canning Company, Rogers Canning Company, and Smith Frozen Foods are served by the municipal water system. Capacity of the South Fork system, when it is in operacion, is 5 MGD. The minimum recorded daily discharge at the U. S. Geological Survey gaging station upstream from the Milton-Freewater intake is 72 cfs (46.5 MGD) and there are no significant diversions or regulation on the river upstream from the intake.

The Milton-Freewater system in 1962 was about 30 per cent metered and served 4,600 people. Total municipal and industrial water usage for the year was 4.3 MGD (1,577 MG) or 4,820 acre-feet, of which 0.62 MGD (227 MG) was supplied by private industrial supplies and 1.53 MGD (558 MG) was supplied to industry by the municipal system. Based on the total water output for municipal use (793 MG), which includes losses, the per capita usage was 472 GPD. Excluding unaccounted for losses (estimated at 238 MG), the per capita demand was 330 GPD.

b. City of Weston

The City of Weston obtains water from two municipal wells located within the city limits, and has a water exchange agreement with Lamb-Weston, Inc., a food processing firm. The water system has approximately 280 connections and serves about 825 people. The system is about 95 per cent metered, but the municipal wells are not metered. Lamb-Weston, Inc., has drilled two deep wells, with a combined maximum yield of approximately 2,500 GPM (3.6 MGD). From

March 28, 1960 to April 4, 1963, the cannery furnished a total of 57 MG (0.05 MGD average) to the City. The two municipal wells within the City have a capacity of 0.65 MGD and are adequate to meet any foreseeable future demands.

It is estimated that the City of Weston used 56 MG of water in 1962. This estimate is based on a per capita demand of 130 GPD (estimated by city officials), a served population of 825 people, and 30 per cent unaccounted for water based on total production. Industrial usage was approximately 260 MG for the year, reflecting the demand of the food processing plant served by this system.

B. Future

1. Study Area

Future municipal and industrial water demand by service areas are shown in Table VII-3. The derivations of figures shown in Table VII-3 are described in the sections to follow.

TABLE VII-3
PROJECTED MUNICIPAL AND INDUSTRIAL WATER DEMAND
STUDY AREA

Location	1985			2010		
	MGD	MG	Ac-Ft.	MGD	MG	Ac-Ft.
Mill Creek Watershed Area:						
Walla Walla.	18.1	6,620	20,300	28.0	10,200	31,325
College Place. . . .	1.3	470	1,435	2.0	730	2,230
Upper Walla Walla Basin Area						
Milton-Freewater . .	7.8	2,830	8,730	12.7	4,600	14,260
Weston	1.9	695	2,180	3.2	1,170	3,635
TOTAL	29.1	10,615	32,645	45.9	16,700	51,450

2. Mill Creek Watershed Area

a. City of Walla Walla

In projecting the municipal demand in this area, it was assumed that the unaccounted for water discussed in Section A-2a of this chapter will remain at the present level of 1,770 MG per year since new additions to the transmission system, when needed, should not add any significant losses to the system. On this basis, future losses will be accounted for and the overall percentage will be reduced to a more reasonable level.

Based on studies of per capita water uses and apparent trends toward increased per capita demands in other areas of the Columbia River Basin, the per capita usage figure of 155 GPD shown in Section A-2a of this chapter was increased at the rate of 1 GPCD per year or to 175 GPCD for the year 1985 and 200 GPCD for the year 2010.

By applying the adjusted per capita demand to projected population, the 1985 municipal demand is 12.1 MGD (4,420 MG) and the 2010 demand is 18.1 MGD (6,620 MG). In this manner, the unaccounted for water for 1985 represents about 40 per cent of the total municipal demand and for 2010 represents about 26 per cent of the total municipal demand.

Industrial water demand was projected by means of crop production projections contained in Chapter VI. The ratio of product output to water use was assumed constant for all types of food products at all times of the year.

Table VII-4 summarizes the projected municipal and industrial water demand estimated for the Walla Walla area.

TABLE VII-4

PROJECTED MUNICIPAL & INDUSTRIAL WATER DEMAND
CITY OF WALLA WALLA, WASHINGTON*
1985 & 2010

MONTH	Municipal				Industrial				Total			
	1985		2010		1985		2010		1985		2010	
	MGD	Ac-Ft.	MGD	Ac-Ft.	MGD	Ac-Ft.	MGD	Ac-Ft.	MGD	Ac-Ft.	MGD	Ac-Ft.
January	9.1	865	13.7	1,300	3.6	340	5.8	550	12.7	1,205	19.5	1,850
February	10.4	895	15.6	1,340	3.9	335	6.4	550	14.4	1,230	22.0	1,890
March	10.2	970	15.3	1,450	2.1	200	3.4	325	12.3	1,170	18.7	1,775
April	9.1	835	13.6	1,250	4.0	370	6.6	610	13.1	1,205	20.2	1,860
May	8.6	790	12.9	1,220	7.3	695	11.9	1,130	15.9	1,485	24.8	2,350
June	16.9	1,555	25.3	2,325	7.5	690	12.3	1,130	24.4	2,245	37.6	3,455
July	21.1	2,010	31.7	3,015	7.3	695	11.9	1,130	28.4	2,705	43.6	4,145
August	17.4	1,650	26.1	2,470	7.3	695	11.9	1,130	24.7	2,345	38.0	3,600
September	14.0	1,290	21.0	1,930	7.5	690	12.3	1,130	21.6	1,980	33.4	3,060
October	10.0	950	14.9	1,415	7.3	695	11.9	1,130	17.2	1,645	26.8	2,545
November	9.4	865	14.1	1,295	7.5	690	12.3	1,130	16.9	1,555	26.4	2,425
December	8.8	835	13.1	1,240	7.3	695	11.9	1,130	16.1	1,530	25.2	2,370
	12.1	13,510	18.1	20,250	6.0	6,790	9.9	11,075	18.2	20,300	28.0	31,325

* Projected population served: 1985 - 41,500;
2010 - 66,400.

b. City of College Place

For projection purposes, the 1985 and 2010 per capita consumption figures for this area were held constant at 200 GPD. The monthly demand profile was considered identical to that of the City of Walla Walla. Projected demands for the City of College Place and suburban Walla Walla area are shown in Table VII-5.

TABLE VII-5
PROJECTED WATER SUPPLY REQUIREMENTS[1/] FOR THE COLLEGE PLACE AREA[2/] & SUBURBAN WALLA WALLA AREA

Location	1985			2010		
	MGD	MG	Ac-Ft.	MGD	MG	Ac-Ft.
College Place	1.15	420	1,285	1.84	670	2,050
Suburban Walla Walla.	0.14	50	150	0.16	60	180

1/ Based on 1985 and 2010 projected population at College Place (5,730 and 9,150, respectively) and 200 GPCD.
2/ No industrial demand exists and none is projected for the College Place area.

3. Upper Walla Walla Basin Area

a. City of Milton-Freewater

Future municipal water requirements in this area were projected on the basis of (1) a reduction in the metered municipal per capita consumption rate due to full metering (330 to 230 GPD), (2) future losses being held at present level, and (3) the projected population. Future industrial water demands were based on projected industrial production levels.

Table VII-6 presents the estimated future municipal and industrial water requirements for the Milton-Freewater area.

TABLE VII-6
PROJECTED MUNICIPAL & INDUSTRIAL WATER DEMAND
CITY OF MILTON-FREEWATER, OREGON*

Month	Municipal[1/]				Industrial[1/]				Total			
	1985		2010		1985		2010		1985		2010	
	MGD	Ac-Ft.	MGD	Ac-Ft.	MGD	Ac-Ft.	MGD	Ac-Ft.	MGD	Ac-Ft.	MGD	Ac-Ft.
January	0.87	83	1.41	134	2.2	208	3.6	343	3.07	291	4.51	477
February	0.93	89	1.50	143	2.4	208	4.0	343	3.43	297	5.50	486
March	1.03	98	1.66	158	0.9	86	1.5	141	1.93	184	3.16	299
April	1.61	153	2.59	247	1.4	129	2.3	211	3.01	282	4.89	458
May	1.73	165	2.79	266	7.5	710	12.2	1,162	9.23	875	14.99	1,428
June	3.19	304	5.14	489	7.7	710	12.7	1,162	10.89	1,014	17.84	1,651
July	6.82	649	10.9	1,041	7.5	710	12.2	1,162	14.32	1,359	23.1	2,203
August	2.22	212	3.58	341	7.5	710	12.2	1,162	9.72	922	15.78	1,503
September	3.26	310	5.24	498	7.7	710	12.7	1,162	10.96	1,020	17.94	1,660
October	0.64	61	1.04	99	7.5	710	12.2	1,162	8.14	771	13.24	1,261
November	2.51	239	4.04	385	7.7	710	12.7	1,162	10.21	949	16.74	1,547
December	0.70	67	1.14	109	7.5	710	12.2	1,162	8.20	777	13.34	1,271
	2.17	2,430[2/]	3.50	3,910[3/]	5.6	6,311	9.2	10,334	7.75	8,741	12.6	14,244

* Projected population served: 1985 - 6,625; 2010 - 12,300.

1/ Monthly municipal and industrial water consumption profiles have been assumed to be the same as the profile established in 1962.

2/ 230 GPCD x 6625 x 365 = 556 MG
556 + 238 = 794 MG or 2,430 acre-feet
The 238 MG represents losses which were taken as 30% of the 1962 usage.

3/ 230 GPCD x 12,300 x 365 = 1,033 MG
1,033 MG + 238 MG = 1,271 MG or 3,910 acre-feet
Losses were assumed to remain at 238 MG

b. City of Weston

As in other areas, the per capita demand in the Weston area is expected to increase. It is assumed, for projection purposes, that the rate will increase to 165 GPCD and 200 GPCD by the years 1985 and 2010, respectively. Unaccounted for water is assumed to be 15 per cent by 1985 and 10 per cent by 2010. Industrial water consumption amounted to 262 MG in 1962, and was projected according to industrial growth rates. Future water requirements for the Weston area are shown in Table VII-7.

C. Needs for Storage

By comparing the future demands described above with supplies available at each location, it is apparent, at this time, that adequate supplies are available to meet future demands in all areas over the study period, except in the Walla Walla, Washington area, below the project site.

As shown in Table VII-8, the demand for municipal and industrial water in the Walla Walla area is projected to be 29.2 MGD (20,300 acre-feet) by 1985 and 45.8 MGD (31,300 acre-feet) by the year 2010. The estimated annual supply available from Mill Creek, based upon the present water right limitation and supplemental wells, is 19,900 acre-feet. There is a need, therefore, for storage to yield about 11,500 acre-feet of water (10.2 MGD) for municipal and industrial purposes in the Walla Walla-College Place area by the year 2010, with first need beginning about the year 1980.

TABLE VII-7
PROJECTED MUNICIPAL & INDUSTRIAL WATER DEMAND
FOR THE CITY OF WESTON, OREGON
1985 & 2010

Month	Municipal				Industrial				Total			
	1985		2010		1985		2010		1985		2010	
	MGD	Ac-Ft.	MGD	Ac-Ft.	MGD	Ac-Ft.	MGD	Ac-Ft.	MGD	Ac-Ft.	MGD	Ac-Ft.
January	0.10	9	0.19	18	0.45	43	0.74	70	0.55	52	0.94	89
February	0.11	9	0.25	21	0.50	43	0.82	70	0.61	52	1.07	92
March	0.10	9	0.22	21	0.38	37	0.65	61	0.48	46	0.87	83
April	0.17	15	0.36	34	0.40	37	0.67	61	0.57	52	1.03	95
May	0.19	18	0.38	37	2.36 1/	208	3.62 2/	343	2.55	226	4.00	380
June	0.33	31	0.73	68	2.27	208	3.74	343	2.60	239	4.47	410
July	0.70	68	1.44	138	2.20	208	3.62	343	2.90	276	5.06	481
August	0.22	21	0.48	46	2.20	208	3.62	343	2.42	229	4.10	389
September	0.36	34	0.73	68	2.27	208	3.74	343	2.63	242	4.47	410
October	0.06	6	0.13	12	2.20	208	3.62	343	2.26	214	3.74	355
November	0.27	24	0.52	49	2.27	208	3.74	343	2.54	232	4.26	392
December	0.06	6	0.16	15	2.20	208	3.62	343	2.26	214	3.78	358
	0.22	250	0.47	527	1.64	1,824	2.68	3,006	1.86	2,074	3.16	3,534

1/ May through December figures obtained by multiplying 1962 July-August average by growth factor 1.5620 (1.8% per year to 1985).

2/ May through December figures obtained by multiplying 1985 figure by growth factor of 1.6406 (2.0% per year from 1985 to 2010).

TABLE VII-8
FUTURE STUDY AREA WATER REQUIREMENTS
(Acre-Feet)

Location	M&I Water Demand 1985	M&I Water Demand 2010	Supply Available 1985	Supply Available 2010	Supply Deficit 1985	Supply Deficit 2010
Mill Creek Watershed Area						
Walla Walla. . . .	20,300	31,300	19,900[a]	19,900[a]	400	11,400
College Place. . .	1,435	2,230	No Limit [b]		---	---
Upper Walla Walla Basin Area						
Milton-Freewater . .	8,730	14,260	17,900[c]	17,900[c]	---	---
Weston	2,180	3,635	3,700[d]	3,700[d]	---	---
TOTAL	32,645	51,425	41,500	41,500	400	11,400
(Ave. MGD).	(29.6)	(46.7)	(37.2)	(37.2)	(0.36)	(10.2)

[a] Water right and supplemental wells totalling 15,600 acre-feet and assuming one more well at 4,300 acre-feet.

[b] Based on 1963 Municipal Water Facilities Inventory, USPHS.

[c] Assumes no further source development.

[d] Based on municipal capacity of 0.65 MGD and available industrial supply of 1,850 GPM. Maximum industrial yield could be as high as 2,500 GPM.

VIII. WATER QUALITY CONTROL

A. Water Uses

1. General

Surface waters in the study area are used for municipal and industrial supply, irrigation, fisheries, recreation, and disposal of treated wastes.

2. Municipal & Industrial Water Supply

Areas in which surface water for municipal and industrial water supply are utilized are detailed in Chapter VII. Springs and upper reaches of mountain streams with small impoundments, long transmission lines, and little or no treatment have traditionally been developed.

3. Irrigation

The agricultural economy of the study area is dependent largely upon a dependable source of water for irrigation. Essentially all of the natural summer flow of streams in the area is allocated to and is presently used for irrigation.

4. Fisheries

Steelhead spawning areas in Mill Creek are located upstream from the City of Walla Walla. Mill Creek, downstream from the City, is principally a transportation route for adult steelhead from February through May and for juvenile fish from October through early July. Stream flows are not critical through most of this particular

period. The potential spawning and rearing areas are largely upstream from the dam site. Migratory fish are presently blocked by the unladdered flood control dam which diverts high flows into the existing Mill Creek Reservoir. In the stream reach adjacent to Walla Walla, concrete groins constructed across Mill Creek at about 60-foot intervals form excellent rearing pools for resident trout and migrant steelhead in the 3-mile reach downstream from the flood control dam. A "put-and-take" trout fishery is maintained in this area. According to the Fish and Wildlife Service, Mill Creek and the Walla Walla River could support additional steelhead and salmonid fish runs if water of satisfactory quality and quantity were available and if fish passage facilities were provided. This agency has further stated that the present value of the fishery in Mill Creek is about $46,000 and there is potential to increase this to about $129,000 with improved water quality.

Water pollution and low summer flows downstream from Walla Walla interferewith migration of juvenile steelhead during the summer and fall months. The Washington State Department of Game has stated that they "would be most interested in maintaining and developing the steelhead runs in Mill Creek, if the water quality and quantity were improved to the extent that we felt such a development would be feasible".

At present, steelhead is the only species of anadromous fish to be found in the Walla Walla River or Mill Creek. It is reported that prior to 1914 sizable runs of spring and fall chinook salmon were

also present in this area. Low flows and degraded water quality, however, prohibit their existence. Also, the Walla Walla River upstream from the mouth of Mill Creek has a pervious section through which considerable flow is lost. This loss, in addition to diversions for irrigation, presents a barrier to upstream migration as this section, at times, has no flow.

5. Recreation

Mill Creek and the Walla Walla River are relatively inaccessible and have not been developed extensively for public recreation. Activities on the streams are mainly sports fishing. The condition and aesthetic attractiveness of Mill Creek and Walla Walla River are important assets to the setting of Whitman National Monument, which is located near the confluence of the two streams.

B. Present & Projected Waste Loadings

1. Present

a. Mill Creek Watershed Area

The waste treatment plant at Walla Walla serves approximately 26,000 people and is used to treat food processing wastes from two freezing plants and one cannery. The characteristics of these wastes (corn, peas, asparagus, etc.) vary with the season. Pea-processing wastes have caused particular treatment difficulties in recent years.

Attempts are being made by the City to improve plant facilities and operation. Treatment efficiencies, averaging 40 to 50 per cent BOD removal during the pea-processing season, are currently being achieved. Some of the plant effluent is diverted to land for

irrigation. Heavy slime growths, however, have disrupted irrigation operations and have produced offensive odors. Irrigation districts in the vicinity of the plant have the right but are not compelled to utilize up to 11 cfs (7.1 MGD) or about 50 per cent of the total treatment plant effluent.

The present average daily BOD load on the treatment plant during the pea-processing season is estimated at about 308,000 population equivalents (PE). With present plant efficiencies and partial disposal of plant effluents to land for irrigation, an efficiency level of about 75 per cent BOD removal in terms of waste received in Mill Creek can be achieved.

College Place is served by a two-stage trickling filter plant. The total raw waste load is about 3,200 PE, with no significant industrial wastes present. All of the plant effluent is diverted to land for irrigation on a continuous basis from May through November. The effluent (about 500 PE) is discharged to the Walla Walla River from December through April.

b. Upper Walla Walla Basin Area

The Milton-Freewater sewage treatment plant treats a municipal load of 4,600 PE and handles no significant industrial waste. The sewage effluent from the plant is fed to an irrigation outfall line which is used jointly by three local canneries. The industrial load of 258,000 PE, along with the municipal load, is applied to land for irrigation purposes about 6 miles from the City. No waste loads are discharged directly to the Walla Walla River in this area.

The treatment plant at Weston treats sewage waste from a population of about 800 persons. No industrial wastes are handled by the plant. Wastes produced by the cannery at Weston are distributed over 200 acres of sloping land and on 30 acres of flat land just west of town. Excess flow and runoff water drain into several lagoons near Pine Creek. It is estimated that daily loads to Pine Creek from this source amount to about 30 pounds of BOD or 180 PE during processing seasons.

2. Future

a. Study Area

The distribution of present and projected waste production for the study area is shown in Table VIII-1. Future design loads shown for each area are those remaining after allowance for adequate waste treatment (85 per cent BOD removal) was applied. Waste production was projected on the basis of population and industrial growth described in Chapter VI.

b. Mill Creek Watershed Area

Future waste production in the Mill Creek Project area is expected to vary seasonally in much the same manner as variations have taken place in the past. Table VIII-2 shows an approximate waste production profile for the Walla Walla area under present and projected conditions. The annual profiles shown in Table VIII-2 for Walla Walla, together with average production for College Place shown in Table VIII-1, form the basis for quality control evaluations to follow.

TABLE VIII-1

PRESENT AND PROJECTED MUNICIPAL AND INDUSTRIAL WASTE*

Location	1962 Pop. Served	1962 Raw PE	1962 Design Load PE	1985 Pop. Served	1985 Raw PE	1985 Design Load PE	2010 Pop. Served	2010 Raw PE	2010 Design Load PE
MILL CREEK WATERSHED AREA									
Walla Walla									
Municipal	26,000	48,000[a]	12,000[c]	41,500	77,000[b]	11,500[c]	66,400	122,000[b]	18,300[c]
Industrial	X	260,000	164,000[c]	X	368,000	37,000[c]	X	588,000	58,800[c]
College Place									
Municipal	3,200	3,200	500[d]	5,730	5,730	860[d]	9,150	9,150	1,370[d]
Industrial	X	--	--	X	--	--	X	--	--
UPPER WALLA WALLA BASIN AREA									
Milton-Freewater									
Municipal	4,600	4,600	1,150[d]	6,625	6,625	975[d]	12,300	12,300	1,850
Industrial	X	258,000	Land	X	383,000	Land	X	624,000	Land
Weston									
Municipal	800	800	200[e]	1,160	1,160	175[e]	2,100	2,100	315[e]
Industrial	X	88,000	Land	X	108,000	Land	X	182,000	Land

* Average industrial waste during food processing season.

a/ Based on BOD and influent flow data.

b/ Ratio of 1962 municipal waste loading (PE) to population served was assumed unchanged for 1985 & 2010.

c/ Discharged to Mill Creek.

d/ To land irrigation.

e/ To Pine Creek.

NOTE: 1960 Population - Walla Walla 24,536; College Place 4,031; Milton Freewater 4,110; Weston 783.

TABLE VIII-2
RAW MUNICIPAL & INDUSTRIAL WASTE PRODUCTION
WALLA WALLA AREA

Month	Raw Waste (Population Equivalents)		
	1962	1985	2010
January	117,000	168,000	269,000
February	117,000	168,000	269,000
March	91,000	129,000	208,000
April	123,000	175,000	284,000
May	165,000	227,000	366,000
June	212,000	303,000	485,000
July	310,000	445,000	710,000
August	310,000	445,000	710,000
September	248,000	354,000	577,000
October	262,000	372,000	615,000
November	248,000	354,000	577,000
December	183,000	261,000	424,000

C. Water Quality Objectives

For purposes of this report, consideration was given to those indicators of water quality which could most effectively be improved and maintained by stream flow regulation. Flow regulation for control of dissolved oxygen (DO), as affected by residual organic waste and organic constituents contained in land drainage, would provide significant protection of water uses described in Section A of this chapter. Maintenance of DO for anadromous fish passage and resident fish propagation would provide conditions suitable for complete multiple use of the stream.

Based on literature reviews and other data available on quality requirements for passage of anadromous fish, a DO objective of 6 milligrams per liter (mg/l) for downstream reaches of Mill Creek was selected.

The highest use of the stream would be provided at this level. Maintenance of a minimum of 6 mg/l DO in this reach would provide greater than 6 mg/l in upper reaches where fish spawning and rearing requiring 7 mg/l would be expected to take place.

A DO level of 2 mg/l would provide minimum protection of public health and only marginal acceptability of the appearance of stream waters. While control of quality at this level will not guarantee fish and aquatic life within the critical zone, it will reduce the concentration of waste and reduce the effects of waste when diverted to irrigation ditches where reaeration would be less than that occurring within the stream itself. This level of control would provide minimum protection against degradation of the aesthetic appearance of the stream, though it would not support a reliable fishery nor, of course, an anadromous fishery.

Stream flows for maintenance of a minimum DO at levels higher than 2 mg/l would provide greater protection and control of aesthetic conditions and other values within and along the stream. Additional capacity to control day-to-day fluctuations in waste treatment efficiencies and to receive uncontrolled urban and rural land runoff would be provided at this level. Control at higher levels would also provide added protection during lag periods when waste treatment facilities are being brought to design efficiencies. Recreational opportunities and a "put-and-take" fishery program might also be made possible at higher DO levels (4 to 5 mg/l in critical zone), particularly during the early years of the project.

Flow regulation for maintenance of DO at 6 mg/1 would, in addition to serving the above-mentioned uses, provide conditions suitable for re-establishment of the salmonid fishery and for a self-sustained resident fishery. Control of stream temperatures to 65 degrees Fahrenheit would also be necessary to provide a favorable condition for the re-establishment of the salmonid fishery.

D. Stream Flow Regulation Requirements

Survey data collected in July, 1963, by the U. S. Public Health Service, show very low levels of DO in lower reaches of Mill Creek under present waste-loading and land-drainage conditions. These data are shown in Appendix B.

Computations based on projected waste loads at Walla Walla, using a range (2 mg/1 to 6 mg/1) of dissolved oxygen and BOD reduction (85 per cent and 90 per cent), were performed to determine flow regulation requirements for water quality control in Mill Creek under a variety of conditions. The results of these computations when compared to design one-in-ten year low flows show that insufficient flow is available in lower Mill Creek to maintain minimum protection of water quality under present and future conditions even with higher levels of waste treatment than are presently provided.

The "Federal Water Pollution Control Act (33 U.S.C. 466 b (b))" provides that the inclusion of storage for regulation of stream flow for the purpose of water quality control shall not be provided as a substitute for adequate treatment or other methods of controlling waste

at the sources. Adequate treatment is considered by the Public Health Service to mean effective waste collection and secondary treatment for domestic wastes and equivalent reduction of industrial waste loads by a combination of process control, internal waste savings, water reuse and effluent treatment. At the present time, efficiently operated trickling filter plants, widely used in intermediate sized communities, are considered capable of 80 to 90 per cent BOD removal while activated sludge is considered capable of 85 to 95 per cent removal. Considering the effect of diurnal fluctuations in waste loads, problems of efficient operation to maintain such high removals, experience with the lags in plant construction to provide for growth in waste loads, and urban storm water and/or combined sewer overflows, it is considered reasonable to expect the equivalent of 85 per cent removal of BOD in well operated collection systems and treatment plants at this time. In this study area, where the largest waste loads are from the food processing industry and where land disposal of waste is practiced, it is believed that a BOD reduction of 90 per cent with respect to the stream is feasible for the future and has been used for design purposes in this report.

Flow requirements, in combination with treatment levels of 85 and 90 per cent BOD reduction to achieve DO levels ranging from 2 to 6 mg/l in the critical zone, were computed for present and future loading conditions in Mill Creek. Comparisons between requirements at the two treatment levels for DO concentrations of 2, 4, and 6 mg/l are

illustrated in Tables VIII-3 through VIII-7, and are compared in these tables with the design one-in-ten year low-flow recurrence frequency for Mill Creek. Flow deficiencies at the two treatment levels for present and future years are summarized in Figure 2.

No deficits would occur during the months of December through May based on the present natural flow regimen of Mill Creek. With inclusion of the proposed Mill Creek Project in the stream system, winter flows would be reduced greatly during reservoir filling. A flow of 10 cfs during winter and spring months to the year 2010 would provide adequate DO for fish life.

With adequate control of wastes at the source (90 per cent BOD removal in terms of the waste received in the stream), the total average required flow in Mill Creek during summer and fall months by the end of the study period to provide optimum use of Mill Creek (5 mg/l) would be about 95 cfs. On a one-in-ten year low-flow frequency basis, there would be an average deficit of about 85 cfs, requiring an annual draft-on-storage of 30,000 acre-feet. An annual draft-on-storage of 54,500 acre-feet would be required to maintain water quality for salmonid fish production (6 mg/l DO). The minimum draft-on-storage for which benefits would accure would be 10,300 acre-feet. This quantity of storage would provide only minimum protection of aesthetic values and would not support fish life.

TABLE VIII-3

FLOW REQUIREMENTS FOR WATER QUALITY CONTROL
IN MILL CREEK AND LOWER WALLA WALLA RIVER 1/
1962

MONTH	Flow Avail. 2/	85% BOD Reduction											
		2 mg/1 DO				4 mg/1 DO				6 mg/1 DO			
		Total Flow Required		Flow Deficit 3/		Total Flow Required		Flow Deficit 3/		Total Flow Required		Flow Deficit 3/	
	cfs	cfs	Ac-Ft.	cfs	Ac-Ft.	cfs	Ac-Ft.	cfs	Ac-Ft.	cfs	Ac-Ft.	cfs	Ac-Ft.
Jan.	55	10	615	---	---	10	615	---	---	10	615	---	---
Feb.	78	10	555	---	---	10	555	---	---	10	555	---	---
March	63	10	615	---	---	10	615	---	---	10	615	---	---
April	80	10	595	---	---	10	595	---	---	10.8	645	---	---
May	47	10	615	---	---	10	615	---	---	23.1	1,420	---	---
June	15	14.9	885	---	---	30.3	1,800	15.3	910	74.0	4,400	59	3,500
July	2	31.7	1,950	29.7	1,830	57.3	3,525	55.3	3,400	170.0	10,450	168	10,300
Aug.	2	31.7	1,950	29.7	1,830	57.3	3,525	55.3	3,400	170.0	10,450	168	10,300
Sept.	2	22.4	1,330	20.4	1,210	40.5	2,495	38.5	2,290	92.0	5,470	90	5,350
Oct.	3	16.9	1,040	14.9	855	28.4	1,530	25.4	1,560	58	3,565	55	3,380
Nov.	20	10.4	620	---	---	18.6	595	---	---	34.2	2,035	14.2	845
Dec.	47	10.0	615	---	---	10.1	615	---	---	10.4	640	---	---
			11,385		5,725		17,080		11,560		40,860		33,675

1/ Lower Walla Walla River defined as downstream from confluence of Walla Walla River and Mill Creek. Flows given are those required immediately above sewage treatment plant.

2/ Taken as the one-in-ten low flow from a statistical analysis of a twenty-two year (1940-62) record of the Mill Creek gaging station at Walla Walla, Washington.

3/ Total flow minus available flow.

NOTE: Table based on assumption of no diversion from sewage treatment plant effluent.

TABLE VIII-4
FLOW REQUIREMENTS FOR WATER QUALITY CONTROL
IN MILL CREEK AND LOWER WALLA WALLA RIVER [1]/
1985

MONTH	Flow Avail.[2]/	85% BOD Reduction											
		2 mg/l DO				4 mg/l DO				6 mg/l DO			
		Total Flow Required		Flow Deficit[3]/		Total Flow Required		Flow Deficit[3]/		Total Flow Required		Flow Deficit[3]/	
	cfs	cfs	Ac-Ft.	cfs	Ac-Ft.	cfs	Ac-Ft.	cfs	Ac-Ft.	cfs	Ac-Ft.	cfs	Ac-Ft.
Jan.	55	10	615	---	---	10	615	---	---	10	615	---	---
Feb.	78	10	555	---	---	10	555	---	---	10	555	---	---
March	63	10	615	---	---	10	615	---	---	10	615	---	---
April	80	10	595	---	---	10	595	---	---	19.5	1,160	---	---
May	47	10	615	---	---	11	675	---	---	28.2	1,735	---	---
June	15	21.8	1,300	6.8	405	43.7	2,600	28.7	1,705	105.8	6,300	90.8	5,400
July	2	50.6	3,120	48.6	2,980	86.9	5,340	84.9	5,220	239.0	14,670	237.0	14,550
Aug.	2	50.6	3,120	48.6	2,980	86.9	5,340	84.9	5,220	239.0	14,670	237.0	14,550
Sept.	2	30.4	1,810	28.4	1,690	56.4	3,260	54.4	3,140	130.0	7,730	128.0	7,610
Oct.	3	22.3	1,370	19.3	1,190	38.7	2,375	35.7	2,190	81.1	4,985	78.1	4,800
Nov.	20	11.2	670	---	---	22.2	1,320	2.2	130	44.5	2,650	24.5	1,460
Dec.	47	10.0	615	---	---	10.0	615	---	---	10.4	600	---	---
			15,000		9,245		23,905		17,605		56,285		48,370

1/ Lower Walla Walla River defined as downstream from confluence of Walla Walla River and Mill Creek. Flows given are those required immediately above sewage treatment plant.

2/ Taken as the one-in-ten flow from a statistical analysis of a twenty-two year (1940-62) record of the Mill Creek gaging station at Walla Walla, Washington.

3/ Total flow minus available flow.

NOTE: Table based on assumption of no diversion from sewage treatment plant.

D.R.T.
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TABLE VIII-5

FLOW REQUIREMENTS FOR WATER QUALITY CONTROL
IN MILL CREEK AND LOWER WALLA WALLA RIVER 1/
1985

MONTH	Flow Avail. 2/	90% BOD Reduction											
		2 mg/1 DO				4 mg/1 DO				6 mg/1 DO			
		Total Flow Required		Flow Deficit 3/		Total Flow Required		Flow Deficit 3/		Total Flow Required		Flow Deficit 3/	
	cfs	cfs	Ac-Ft.	cfs	Ac-Ft.	cfs	Ac-Ft.	cfs	Ac-Ft.	cfs	Ac-Ft.	cfs	Ac-Ft.
Jan.	55	10	615	---	---	10	615	---	---	10	615	---	---
Feb.	78	10	555	---	---	10	555	---	---	10	555	---	---
March	63	10	615	---	---	10	615	---	---	10	615	---	---
April	80	10	595	---	---	10	595	---	---	19.5	1,160	---	---
May	47	10	615	---	---	11	675	---	---	18.8	1,155	---	---
June	15	14.6	870	---	---	29.2	1,735	14.2	845	70.6	4,200	55.6	3,310
July	2	31.8	1,950	29.8	1,830	58.0	3,560	56.0	3,440	159.4	9,800	157.4	9,680
Aug.	2	31.8	1,950	29.8	1,830	58.0	3,560	56.0	3,440	159.4	9,800	157.4	9,680
Sept.	2	18.2	1,080	16.2	960	37.6	2,230	35.6	2,120	86.7	5,150	84.7	5,030
Oct.	3	11.8	725	8.8	540	25.6	1,575	22.6	1,390	54.0	3,320	51.0	3,140
Nov.	20	10.0	670	---	---	14.8	880	---	---	29.6	1,760	9.6	570
Dec.	47	10.0	615	---	---	10.0	615	---	---	10.4	600	---	---
			10,855		5,160		17,210		11,235		38,730		31,410

1/ Lower Walla Walla River defined as downstream from confluence of Walla Walla River and Mill Creek. Flows given are those required immediately above sewage treatment plant.

2/ Taken as the one-in-ten flow from a statistical analysis of a twenty-two year (1940-62) record of the Mill Creek gaging station at Walla Walla, Washington.

3/ Total flow minus available flow.

NOTE: Table based on assumption of partial diversion from sewage treatment plant.

TABLE VIII-6
FLOW REQUIREMENTS FOR WATER QUALITY CONTROL
IN MILL CREEK AND LOWER WALLA WALLA RIVER 1/
2010

Month	Flow Avail. 2/	85% BOD Reduction											
		2 mg/1 DO				4 mg/1 DO				6 mg/1 DO			
		Total Flow Required		Flow Deficit 3/		Total Flow Required		Flow Deficit 3/		Total Flow Required		Flow Deficit 3/	
	cfs	cfs	Ac-Ft.	cfs	Ac-Ft.	cfs	Ac-Ft.	cfs	Ac-Ft.	cfs	Ac-Ft.	cfs	Ac-Ft.
Jan.	55	10	615	---	---	10	615	---	---	10	615	---	---
Feb.	78	10	555	---	---	10	555	---	---	10	555	---	---
March	63	10	615	---	---	10	615	---	---	10	615	---	---
April	80	10	595	---	---	10	595	---	---	26	595	---	---
May	47	10	615	---	---	10	615	---	---	46	615	---	---
June	15	37.2	2,220	22.2	1,320	73	4,350	58	3,450	175	10,420	160	9,520
July	2	81.7	5,025	79.7	4,900	141	8,690	139	8,550	405	24,900	403	24,780
Aug.	2	81.7	5,025	79.7	4,900	141	8,690	139	8,550	405	24,900	403	24,780
Sept.	2	50.7	3,020	48.7	2,900	93	5,540	91	5,410	212	12,600	210	12,500
Oct.	3	38.5	2,370	35.5	2,180	65.5	4,030	62.5	3,840	135	8,300	132	8,150
Nov.	20	19.7	1,170	---	---	37.5	2,240	17.5	1,040	73.6	4,380	53.6	3,190
Dec.	47	10	615	---	---	10	615	---	---	18.5	615	---	---
			22,440		16,200		37,150		30,840		89,110		82,920

1/ Lower Walla Walla River defined as downstream from confluence of Walla Walla River and Mill Creek. Flows given are those required immediately above sewage treatment plant.

2/ Taken as the one-in-ten low flow from a statistical analysis of a twenty-two year (1940-62) record of the Mill Creek gaging station at Walla Walla, Washington.

3/ Total flow minus available flow.

NOTE: Table based on assumption of no diversion from sewage treatment plant effluent.

TABLE VIII-7

FLOW REQUIREMENTS FOR WATER QUALITY CONTROL
IN MILL CREEK AND LOWER WALLA WALLA RIVER 1/
2010

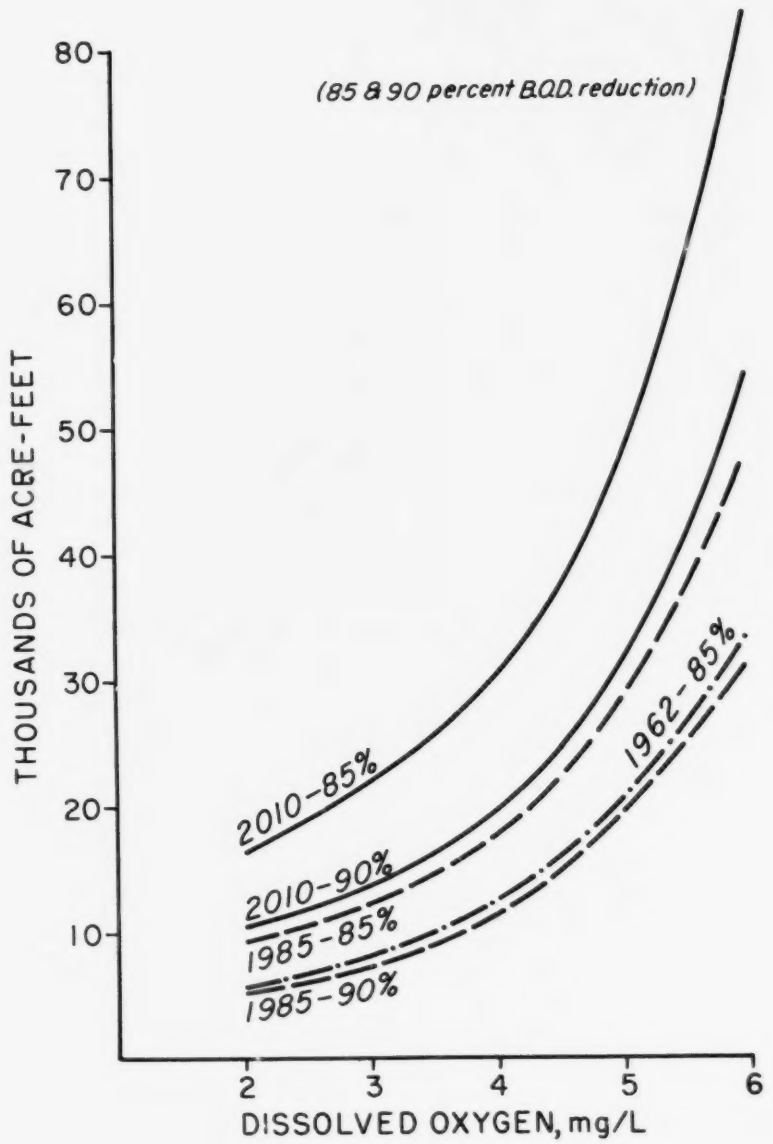
Month	Flow Avail. 2/	90% BOD Reduction											
		2 mg/l DO				4 mg/l DO				6 mg/l DO			
		Total Flow Required		Flow Deficit 3/		Total Flow Required		Flow Deficit 3/		Total Flow Required		Flow Deficit 3/	
	cfs	cfs	Ac-Ft.	cfs	Ac-Ft.	cfs	Ac-Ft.	cfs	Ac-Ft.	cfs	Ac-Ft.	cfs	Ac-Ft.
Jan.	55	10	615	---	---	10	615	---	---	10	615	---	---
Feb.	78	10	555	---	---	10	555	---	---	10	555	---	---
March	63	10	615	---	---	10	615	---	---	10	615	---	---
April	80	10	595	---	---	10	595	---	---	17.3	1,030	---	---
May	47	10	615	---	---	10	615	---	---	30.8	1,890	---	---
June	15	24.8	1,475	9.8	585	48.6	2,890	33.6	2,000	117	6,960	102	6,070
July	2	54.5	3,350	52.5	3,220	94.2	5,790	92.2	5,660	270	16,600	268	16,500
Aug.	2	54.5	3,350	52.5	3,220	94.2	5,790	92.2	5,660	270	16,600	268	16,500
Sept.	2	33.8	2,010	31.8	1,890	62.0	3,690	60.0	3,570	141	8,390	139	8,260
Oct.	3	25.7	1,580	22.7	1,400	43.6	2,680	40.6	2,420	90	5,540	87	5,350
Nov.	20	13.1	780	---	---	25	1,490	5.0	300	49	2,920	29	1,730
Dec.	47	10	615	---	---	10	615	---	---	12.3	760	---	---
			16,155		10,315		25,940		19,610		62,475		54,410

1/ Lower Walla Walla River defined as downstream from confluence of Walla Walla River and Mill Creek. Flows given are those required immediately above sewage treatment plant.

2/ Taken as the one-in-ten low flow from a statistical analysis of a twenty-two year (1940-62) record of the Mill Creek gaging station at Walla Walla, Washington.

3/ Total flow minus available flow.

NOTE: Table based on assumption of partial diversion from sewage treatment plant effluent.



WATER SUPPLY & WATER QUALITY CONTROL STUDY
MILL CREEK WATERSHED
WALLA WALLA RIVER BASIN, WASHINGTON

STORAGE RELEASES vs
DISSOLVED OXYGEN

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
Public Health Service

REGION IX (DATE: 9/65) PORTLAND, OREGON

FIGURE 2

Preliminary studies pertaining to possibilities of controlling the temperature of Mill Creek by releases from storage show that significant control of temperature would accompany releases made to maintain DO at 6 mg/l. For example, releases of 100 cfs at 55 degrees Fahrenheit from the project site made in July may attain a temperature of 70 degrees Fahrenheit at the mouth of Mill Creek. Releases of 200 cfs would be expected to control temperature to 65 degrees Fahrenheit or less. Comprehensive water quality studies in this area will validate these estimates at a later time.

IX. BENEFITS

A. Water Supply--Municipal & Industrial

A future need for storage for municipal and industrial water supply exists in the Walla Walla area, as described in Chapter VII. The need is for an annual yield from storage of 10.2 MGD (11,400 acre-feet) by the end of the study period, with first need beginning about the year 1980. The alternative single purpose cost that would be imposed on local users to develop the needed supply in the absence of the project provides a measure of the benefit assignable to project storage for this purpose. The most likely alternative source available for development in the absence of the project is storage at the proposed project site on Mill Creek.

The annual value of storage in the proposed project for municipal and industrial water supply based on capital cost data (provided by the Corps of Engineers), a 25-year local bonding period at 4 per cent interest adjusted to a 100-year annual equivalent Federal expenditure at 3.125 per cent interest, with a discount period of ten years (assumed project completion in 1970), is estimated to be $321,800.

B. Water Quality Control

Benefits can be assigned to releases from storage for regulation of stream flow for water quality control only after a reasonable degree of treatment or control of waste at the source is provided. In this instance, adequate waste control at the source, or 90 per cent BOD

removal with respect to the stream, would not by itself meet the quality goals discussed in Chapter VIII for Mill Creek. Water quality goals can, however, be met by providing flow regulation in addition to adequate treatment.

Storage releases for control of water quality are needed in Mill Creek to protect fish and wildlife, maintain recreational opportunities, safeguard public health, and preserve the aesthetic attractiveness of stream waters. Monetary benefits applicable to all improvements or damages avoided, however, are impossible to thoroughly evaluate at this time. Economic waste and land treatment methods capable of complete control of all waste materials are not presently known. Many benefits, such as those resulting from temperature reduction, decreased concentrations of dissolved solids, maintenance of the aquatic habitat, increased land values along the stream, and general protection of aesthetic values are particularly difficult to completely assess in monetary terms.

Because of the multiplicity of improvements that would be realized through the control of water quality by flow regulation, the minimum value of storage for this purpose is considered to be at least equal to the cost of an equivalent alternative which would accomplish similar results.

Upon examining several alternatives to flow regulation, it was found that, except for single-purpose storage for this purpose, no other alternatives would provide equivalent control; that is,

maintenance of a live stream within which waste effluents and uncontrolled urban and rural runoff wastes could be diluted and assimilated. The transporting of waste effluents to the Walla Walla River would merely transport problems downstream since extremely low flows also occur in the Walla Walla River. Also, waste waters transported to the Walla Walla River would be unavailable for re-use for irrigation where needed in areas adjacent to Mill Creek. Consideration was also given to the disposal of waste waters underground and to additional disposal on the land. Underground disposal would be expected to interfere with ground-water supplies and additional surface disposal, particularly of pea processing wastes on the limited land areas available, could promote nuisance odor conditions objectionable to residences in the surrounding areas.

A single-purpose reservoir at the Corps of Engineers' project site on Mill Creek was found to be the most likely alternative means of providing the necessary control of water quality. The minimum value of benefits associated with quality control release requirements for full use of Mill Creek (54,400 acre-feet), including a salmonid fishery, based on a 100-year alternate project life, with first need beginning at the time of project completion and at 3.125 per cent interest, is estimated to be $840,000 or $15.50 per acre-foot. For an annual draft-on-storage of less than 54,410 acre-feet, the value would be reduced at the rate of $15.50 per acre-foot down to the minimum of 10,315 acre-feet (nuisance abatement only), below which no value can be assigned to storage for water quality control.

Controlled water quality will have an important impact on the area for which regulation would be provided. The lower 6 miles of Mill Creek and 40 miles of the Walla Walla River would be affected by this control. Intangible benefits, such as public health and the protection of aesthetic values associated with the stream and its condition, will be of increasing importance as population density increases. Mill Creek flows through the City of Walla Walla and on through a number of communities and suburban areas where population growth to more than 75,000 persons is expected. The potential value of the fishery alone is estimated at about $129,000 annually.

The benefits derived from water quality improvement and maintenance in Mill Creek and the Walla Walla River are both tangible and intangible and are widespread both in area and type of beneficiary.

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5. Treatment of Pea Processing Waste Waters at Walla Walla, Washington, 1962; City of Walla Walla Report, August, 1962.

6. Biological Treatment of Pea Processing Waste, Walla Walla, Washington, 1963; Kramer, G. F., August, 1963.

7. Biological Treatment of Pea Processing Waste, Walla Walla, Washington, 1964; Kramer, G. F.

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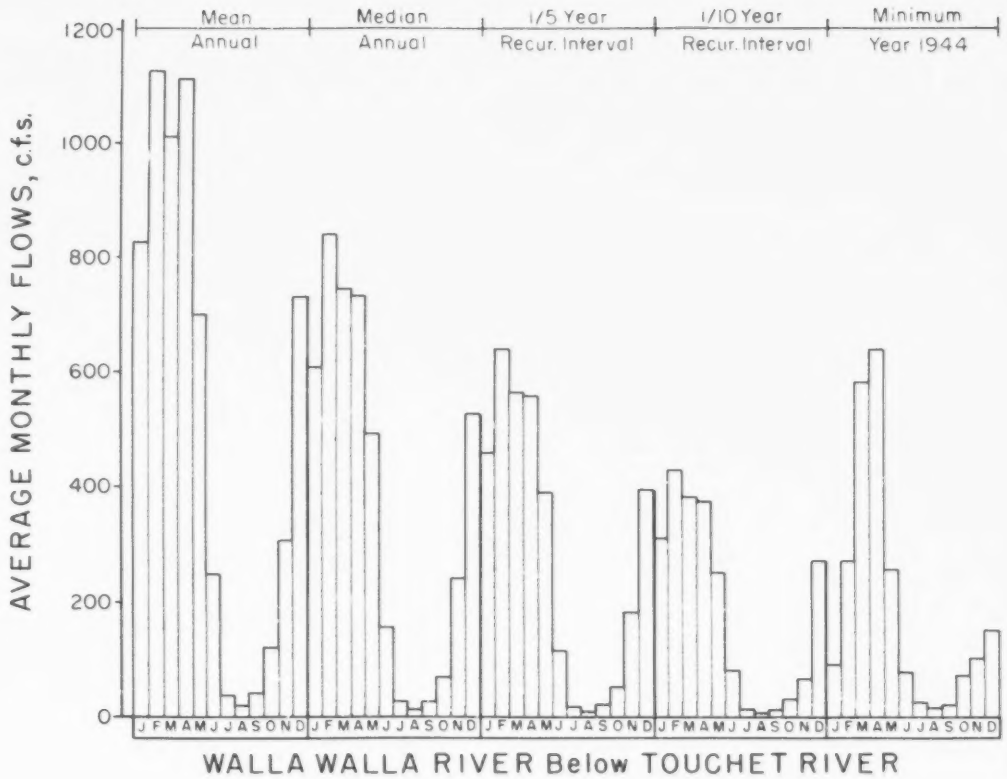
APPENDIX A

HYDROLOGICAL DATA

D.R.T.
5/20/65

SUMMARY OF STREAM FLOW DATA
MILL CREEK STUDY AREA
Based on U.S.G.S. Records, Water Years 1942-1962

Stream Location	River Mile	Mean Annual Flow				Minimum Month Flow			
		Mean Year	Minimum Year	1/5 Year Frequency	1/10 Year Frequency	Mean	Minimum	1/5 Year Freq.	1/10 Year Frequency
Mill Creek Dam Site	16.5								
Ave. Monthly Flow, cfs		115	70	88	74	35	25	29	26
Annual Yield, Ac.-Ft.		83,300	50,600	63,700	53,600				
Mill Creek @ Walla Walla	7.3								
Ave. Monthly Flow, cfs		75	34	50	37	4	1	4	1
Walla Walla River at North & South Forks	41.0								
Ave. Monthly Flow, cfs		230	175	190	176	105	80	88	82
Annual Yield, Ac.-Ft.		166,500	127,000	137,500	127,500				
Walla Walla River at Milton-Freewater	35.0								
Ave. Monthly Flows, cfs		117	37	84	66	12	0	0	0
Walla Walla River Below Touchet	15.0								
Ave. Monthly Flow, cfs		580	394	---	---	14	4	--	--


Mean Annual
Median Annual
1/5 Year Recur. Interval
1/10 Year Recur. Interval
Minimum Year 1944
1200
1000
800
600
400
200
0
AVERAGE MONTHLY FLOWS, c.f.s.
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
WALLA WALLA RIVER Below TOUCHET RIVER

Note:
Based on USGS Records, Water Years 1942 - 1963.

WATER SUPPLY & WATER QUALITY CONTROL STUDY
MILL CREEK WATERSHED
WALLA WALLA RIVER BASIN, WASHINGTON

COMPARATIVE FLOW HYDROGRAPHS

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
Public Health Service

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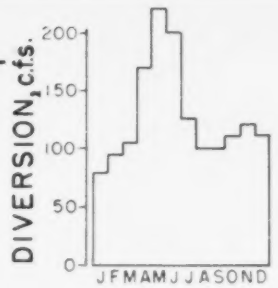
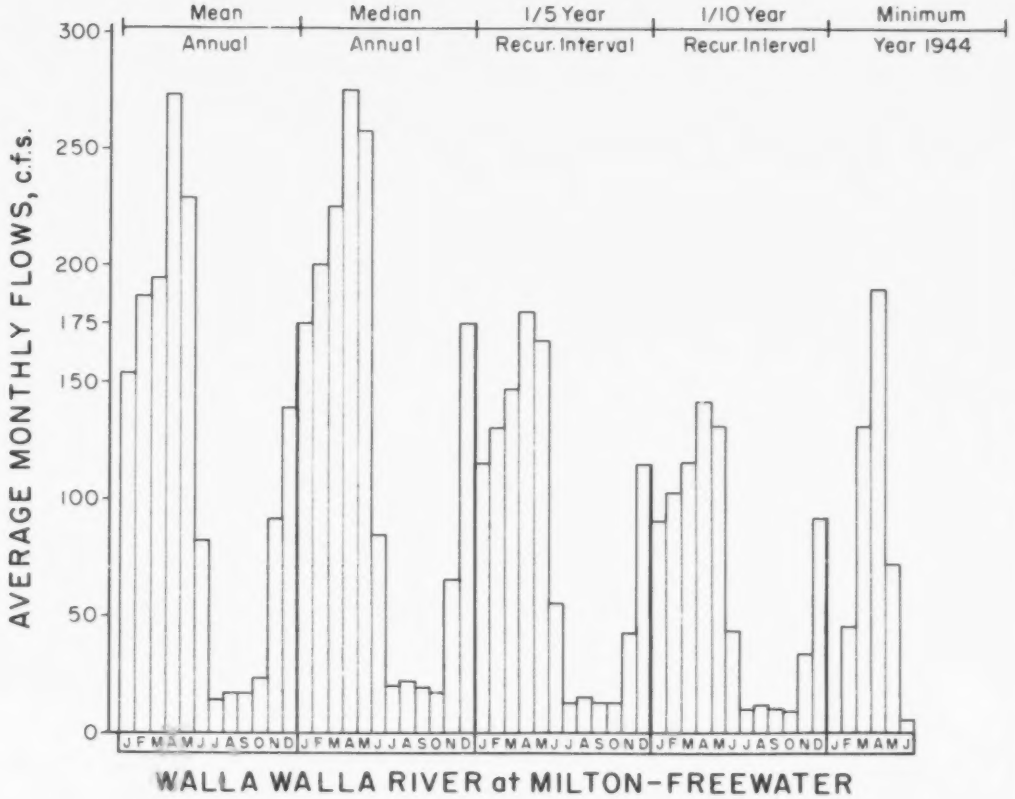
A-3

Ave. Monthly Diversions above Freewater - c.f.s.

(Ave. Annual Diversions, 92,500 Ac-Ft./Year)




Mean Annual
Median Annual
1/5 Year Recur. Interval
1/10 Year Recur. Interval
Minimum Year 1944
AVERAGE MONTHLY FLOWS, c.f.s.
300
250
200
175
150
100
50
0
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J

WALLA WALLA RIVER at MILTON-FREEWATER

Note:

Based on USGS Records, Water Years 1942 - 1962.

WATER SUPPLY & WATER QUALITY CONTROL STUDY
MILL CREEK WATERSHED
WALLA WALLA RIVER BASIN, WASHINGTON

COMPARATIVE FLOW HYDROGRAPHS

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Public Health Service

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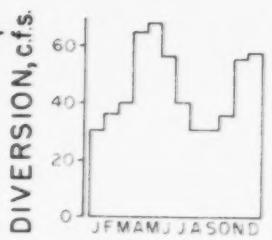
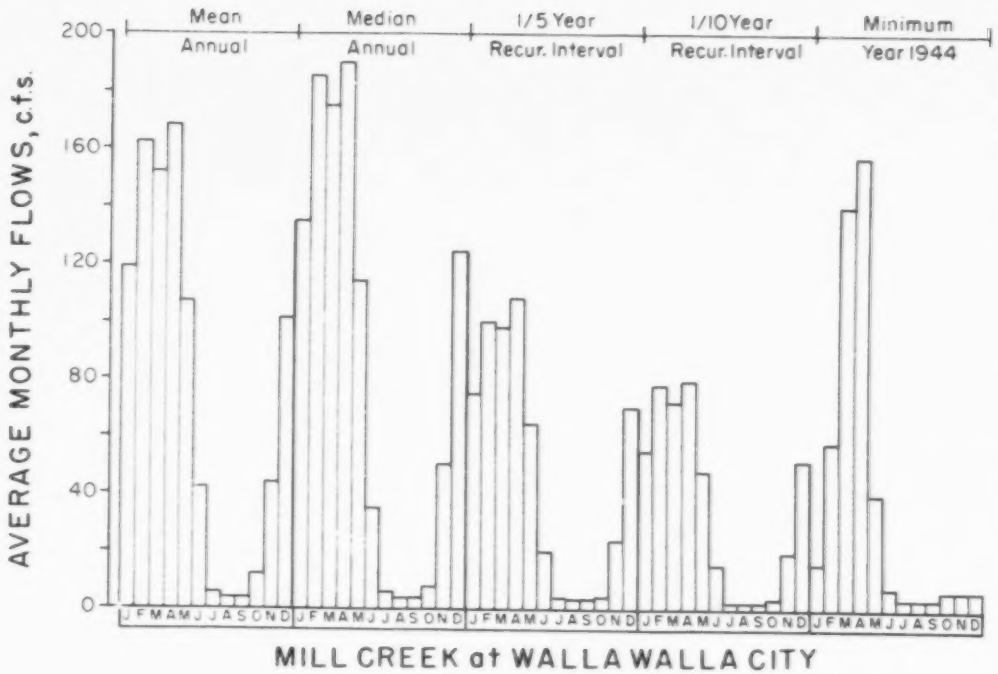
Ave. Monthly Diversions above Walla Walla - c.f.s.

(Ave. Annual Diversions, 32,000 Ac-Ft./Year).





Note:

Based on USGS Records, Water Years 1941 - 1960.

WATER SUPPLY & WATER QUALITY CONTROL STUDY
MILL CREEK WATERSHED
WALLA WALLA RIVER BASIN, WASHINGTON

COMPARATIVE FLOW HYDROGRAPHS

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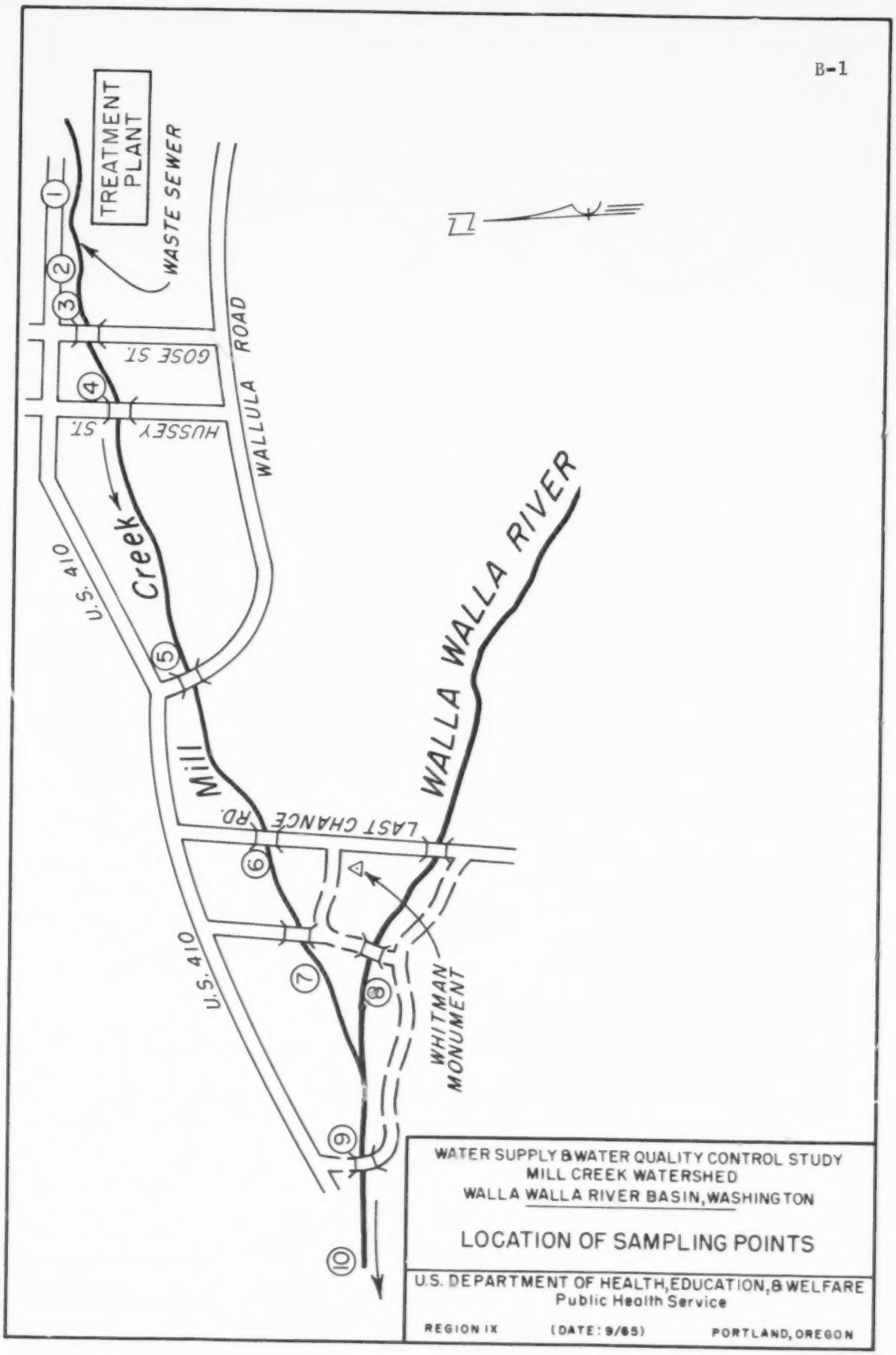
APPENDIX B

WATER QUALITY DATA



WATER SUPPLY & WATER QUALITY CONTROL STUDY
MILL CREEK WATERSHED
WALLA WALLA RIVER BASIN, WASHINGTON

LOCATION OF SAMPLING POINTS

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D.R.T.
7/28/65

APPENDIX B

WATER QUALITY DATA*
MILL CREEK & WALLA WALLA RIVER

Station	May 20	June 13	June 20	June 26	July 2	July 10	July 16
			DO Milligrams per Liter				
1	9.6	8.7	8.4	10.3	10.8	10.3	10.7
2	8.5	4.7	4.0	4.3	5.4	5.8	6.2
3	---	0.7	0.0	1.1	0.3	1.6	0.9
4	---	0.1	0.0	0.3	0.2	1.8	3.8
5	12.0	0.9	0.0	1.4	0.2	3.8	7.6
6	---	1.4	0.0	1.5	0.3	4.6	10.5
7	---	---	3.6	5.4	8.6	9.5	8.2
9	---	10.6	10.6	13.0	9.6	10.4	11.8
			Five-Day BOD Milligrams per Liter				
1	---	-10	-10	-10	-10	-10	-10
2	---	670	360	370	350	65	74
3	---	430	320	490	290	65	57
4	---	430	300	330	240	50	36
5	---	110	165	30	105	ca. 10	-10
6	---	44	120	78	90	-10	-10
7	---	---	-10	-10	ca. 10	-10	-10
9	---	-10	-10	3	-10	-10	-10

Source: G. F. Krahmer - Biological Treatment of Pea Processing Wastes, Walla Walla, Washington, 1963.

Note: "-10" shown above means less than 10.

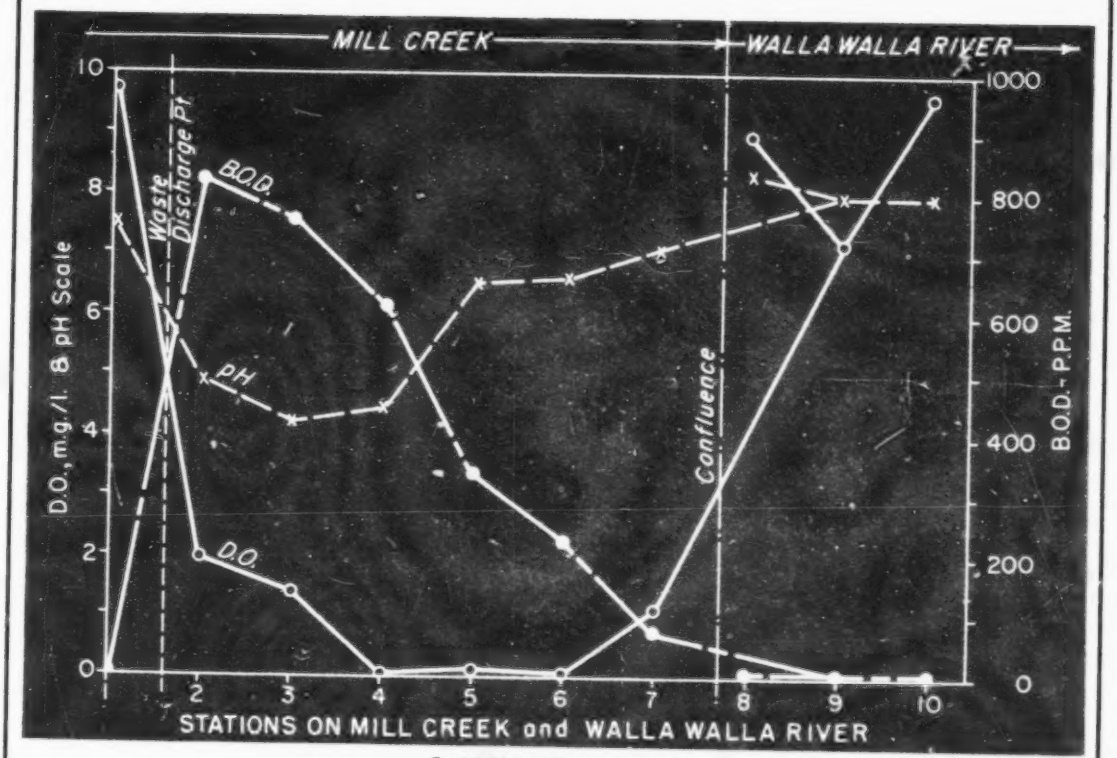
D.R.T.
7/28/65

APPENDIX B

WATER QUALITY DATA COLLECTED BY PHS IN JULY, 1963

Station	Water Temp. °C a/	pH	Concentration in mg/l							
			DO	BOD b/	COD	Phosphates			Nitrogen	
						Ortho	Soluble	Insoluble	Organic	Ammonia
MILL CREEK:										
1. Upstream of Walla Walla STP. . . .	25	7.0	--	-	--	--	--	--	--	--
2. STP Outfall.	23	6.5	5.6	216	423	0.8	1.9	6.9	31.3	18.9
0.25 mi. Downstream from STP	--	6.5	3.0	237	378	2.8	4.4	2.7	33.9	18.7
3. 0.5 mi. Downstream from STP	26	6.5	1.2	211	359	5.2	6.0	1.9	30.1	20.5
4. 1 mi. Downstream from STP	28	6.6	0.6	210	329	4.0	5.0	3.9	19.2	10.0
5. 3 mi. Downstream from STP	25	6.9	0.6	103	171	3.9	4.2	0.0	17.8	10.4
6. 4 mi. Downstream from STP	26	7.0	0.5	104	175	4.7	5.1	0.3	18.3	11.4
7. 5 mi. Downstream from STP	28	7.3	4.4	12	36	2.5	2.4	0.3	5.4	5.1
WALLA WALLA RIVER:										
8. 0.5 mi. above Mill Creek	28	7.9	10.5	2	8	0.5	0.4	0.0	0.9	0.3
9. 0.5 mi. below Mill Creek	28	7.9	9.6	4	6	0.7	0.5	0.0	1.0	1.3

a/ Afternoon (2-5 PM) Water Temperature.
b/ Five-day 20° C BOD.



SUMMER 1959

SOURCE:
Courtesy of Washington State University, Pullman, Washington.

WATER SUPPLY & WATER QUALITY CONTROL STUDY
MILL CREEK WATERSHED
WALLA WALLA RIVER BASIN, WASHINGTON

QUALITY of WASTE RECEIVING WATERS

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APPENDIX C

COMPUTATION OF WATER SUPPLY AND WATER QUALITY CONTROL BENEFITS

COMPUTATION OF MUNICIPAL AND INDUSTRIAL WATER SUPPLY BENEFITS MILL CREEK BASIN, WASHINGTON

1. Assumed dead storage: 6,000 acre-feet.

2. Total storage required: 11,400 + 6,000 = 17,400 acre-feet.

3. Capital cost of reservoir: $11,600,000.

4. Payment stream over 25-year bonding period at 4 per cent:

   $11,600,000 x 0.06401 = $742,500

5. Equivalent Federal investment to provide same payment at 3.125 per cent for 25 years:

   $742,500 x 17.17308 = $12,751,300

6. Average annual Federal cost for 100-year project life:

   $12,751,300 x 0.03276 = $417,700

7. Assuming year of first need is 1980 and that project will be completed by 1970 and discount at 3.125 per cent interest for ten years (after including $20,000 for operation and maintenance costs) to obtain the annual benefit:

   $437,700 x 0.73512 = $321,800

COMPUTATION OF SINGLE PURPOSE WATER QUALITY STORAGE COSTS
MILL CREEK BASIN, WASHINGTON

1. Required annual draft on storage[1/]: 54,410 acre-feet.
2. Dead storage: 10,000 acre-feet.
3. Total reservoir size: 64,410 acre-feet.
4. Annual cost[2/] (100-year basis; includes OM&R): $840,000.
5. Annual value per acre-foot of required quality control water[3/] (100-year basis): $15.50

1/ Shown in Table VIII-7 (page VIII-16). Minimum amount of water for which quality benefits are realized is 10,315 acre-feet.

2/ Based on Corps of Engineers' cost-storage curves.

3/ Calculated for 6 mg/l by 840,000/54,410.

APPENDIX D

DISSOLVED OXYGEN PROFILES
WALLA WALLA RIVER BASIN
MILL CREEK

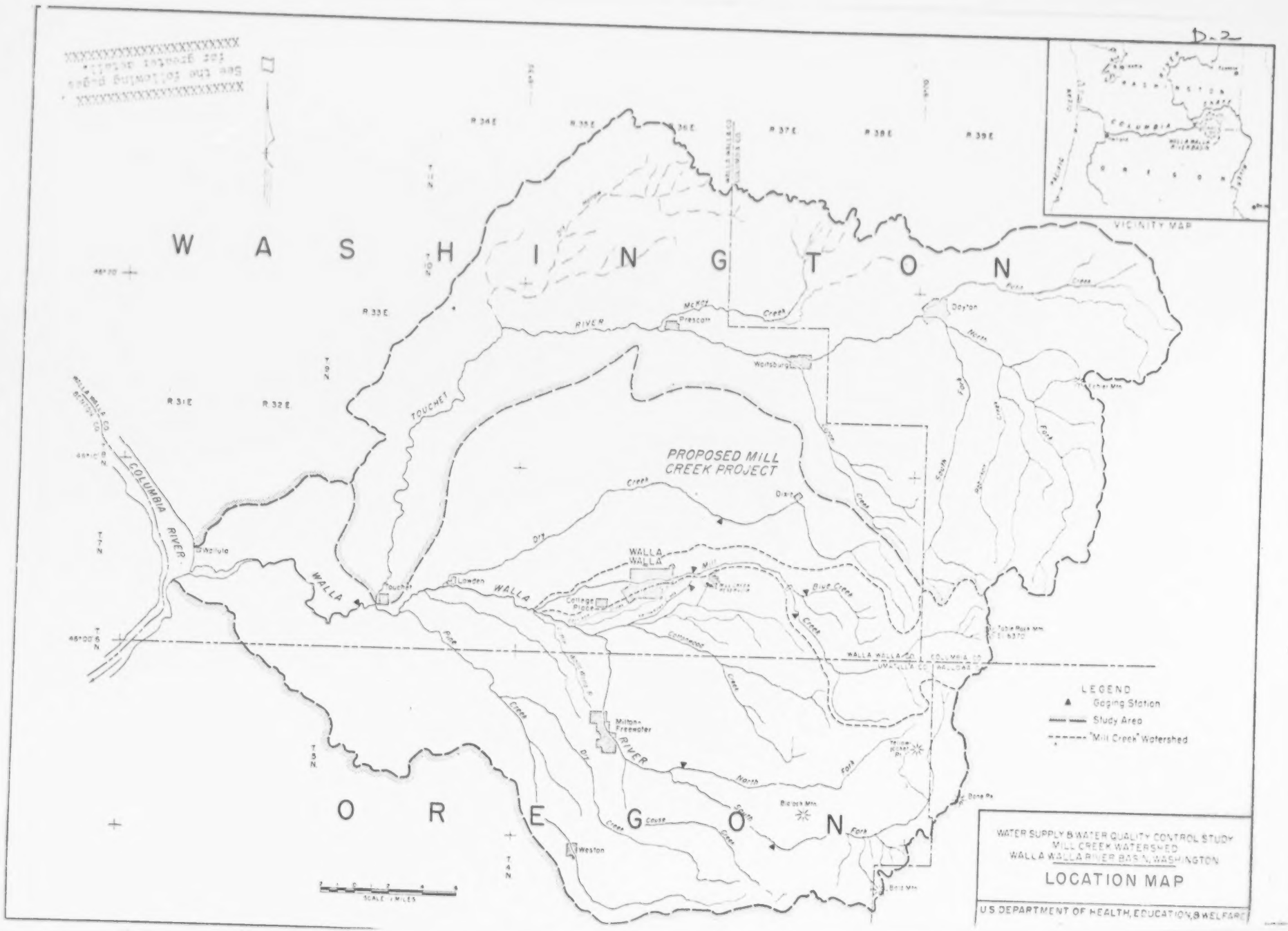
WATER SUPPLY & WATER QUALITY CONTROL STUDY
MILL CREEK WATERSHED
WALLA WALLA RIVER BASIN, WASHINGTON

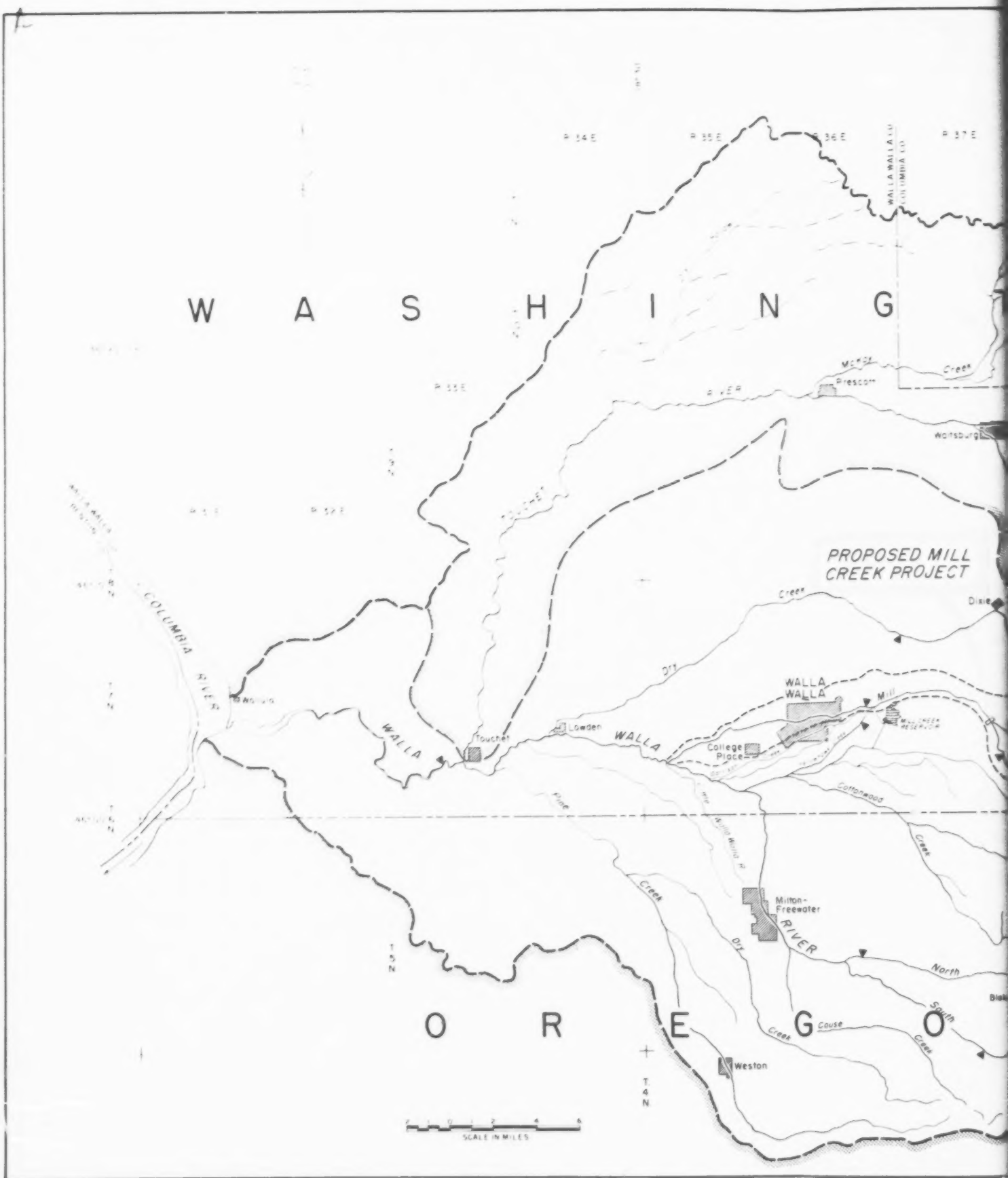
DISSOLVED OXYGEN PROFILE

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
Public Health Service

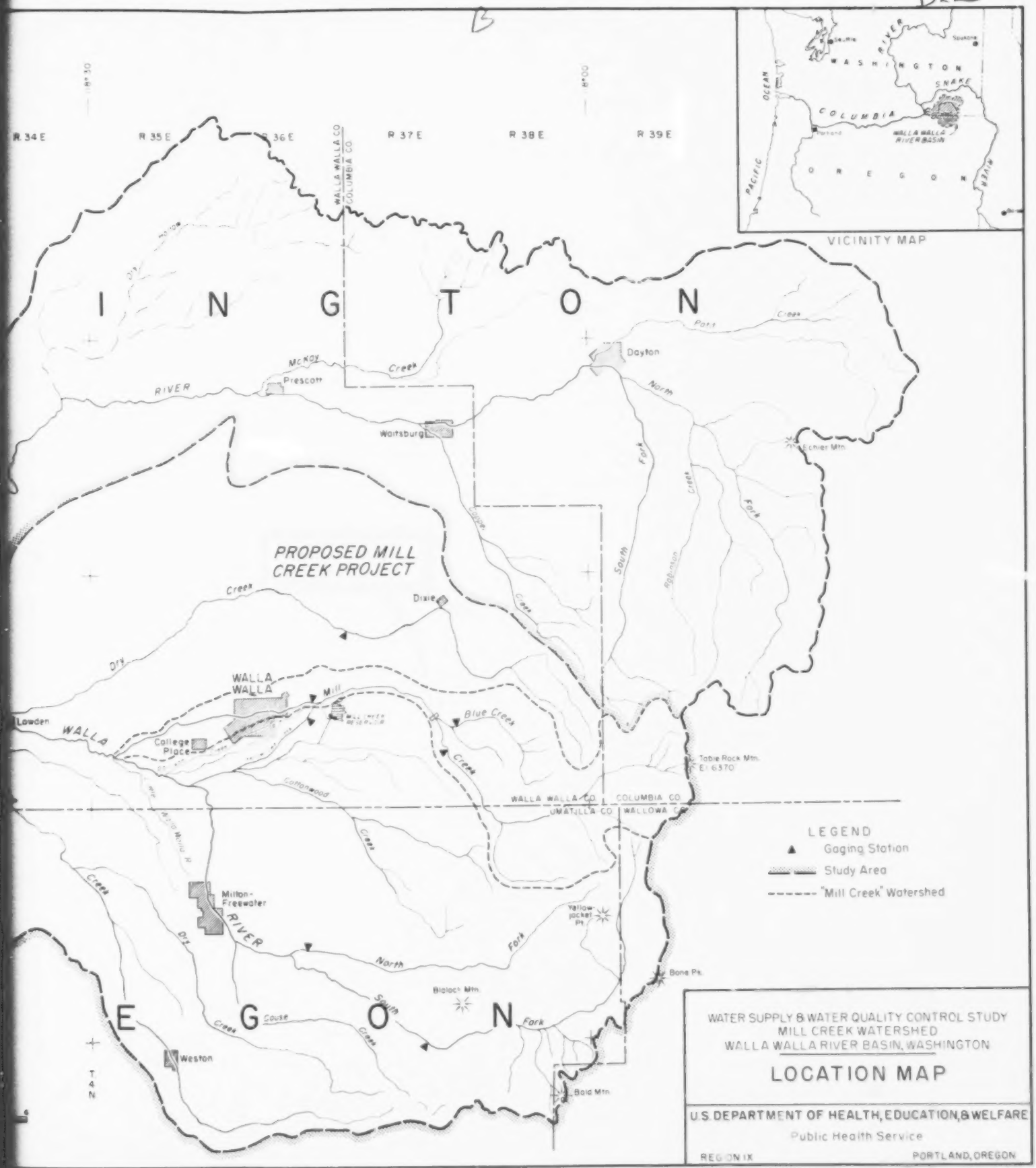
REGION IX (DATE: 9/65) PORTLAND, OREGON

D-2


WASHINGTON
OREGON
PROPOSED MILL CREEK PROJECT
VICINITY MAP
COLUMBIA
WALLA WALLA RIVER BASIN
OREGON
WASHINGTON
R 34 E
R 35 E
R 36 E
R 37 E
R 38 E
R 39 E
R 31 E
R 32 E
R 33 E
T 7 N
T 6 N
T 5 N
T 4 N
T 3 N
T 2 N
T 1 N
COLUMBIA RIVER
TOUCHET
WALLA WALLA
RIVER
Prescott
Wollula
Touchet
Lowden
College Place
Milton-Freewater
Weston
Dayton
Waitsburg
Dixie
Blue Creek
Mill Creek
Patit Creek
Couse Creek
Pine Creek
Coppei Creek
Tatoosh Buttes
Table Rock Mtn.
Bone Pk.
Bald Mtn.
Blalock Mtn.
Rogers Pk.
Mt. Misery
Mt. Pisgah
Mt. Horrible
Mt. Richer
Mt. Patterson
Mt. Misery
WALLA WALLA CO.
COLUMBIA CO.
UMATILLA CO.
WALLOWA CO.
45°00'N
46°00'N
46°30'N
SCALE - MILES
LEGEND
Gaging Station
Study Area
"Mill Creek" Watershed
WATER SUPPLY & WATER QUALITY CONTROL STUDY
MILL CREEK WATERSHED
WALLA WALLA RIVER BASIN, WASHINGTON
LOCATION MAP
U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE


W A S H I N G
O R E G O
PROPOSED MILL CREEK PROJECT
COLUMBIA RIVER
WALLA WALLA
Touchet
Lowden
College Place
Milton-Freewater
Weston
Prescott
Waitsburg
Dixie
Mill Creek Reservoir
Pine Creek
Cottonwood Creek
North Fork Couse Creek
South Fork Couse Creek
Dry Creek
WALLA WALLA RIVER
T 5 N
T 4 N
R 34 E
R 35 E
R 36 E
R 37 E
SCALE IN MILES

D-2



VICINITY MAP

WATER SUPPLY & WATER QUALITY CONTROL STUDY
MILL CREEK WATERSHED
WALLA WALLA RIVER BASIN, WASHINGTON

LOCATION MAP

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
Public Health Service
REGION IX PORTLAND, OREGON